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TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK 33, 48
Water-Power Development at Pelzer, S. C. (illustrated)..... 34
Burnside Shops, Illinois Central R. R., Il. (with inset)..... 34
A Small Asphalt-Lined Reservoir at Indio, Cal.... 35
A Proposed Standard Specification for Portland Cement.. 35
A Portable Drying and Heating Plant (illustated).. 36
Low Level Bridges in Queensland (illustrated)..... 36
A Direct-Acting Steam Pile Hammer (illustrated)... 38
Uniform Methods of Testing Iron and Steel..... 38
Tests of the Efficiency of an Injector (illustrated).... 39
A Traveling Derrick Car (illustrated)..... 39
Legal Decisions of Interest to Engineers..... 44
New Foundry of the Niles Tool Works, Hamilton, O. (illustrated)..... 45
A Union Terminal for Chicago's Elevated Railways (illustrated).... 46
A New Hoisting and Conveying Apparatus (illustrated)..... 46
The Early History of Street Paving and Street Cleaning..... 47
EDITORIAL NOTES..... 40
Disadvantages of Headhouse Passenger Trainsheds at Way Stations—Engineers and Specialists—The Lesson of the Logan Collision—Accidents to Excursion Trains.
EDITORIAL.
The Needs and Possibilities of Harbor Improvement at Chicago 40
LETTERS TO THE EDITOR 42, 43
Diagram of Frog and Switch Values—Civil Service Examination for Construction Inspector—English Sewer Flushing Practice—Car Storage Tracks in Railway Yards—Stability of Steep Earthwork Slopes in the Tropics—Very Low Prices for Reservoir Construction—An Incident of the St. Louis Tornado—Comments on Track Standards—Low Charges for Engineering Work—Tests at the Massachusetts Institute of Technology.

THE SAVAGE RIFLE has been selected as the weapon for the New York militia by the Commission appointed to examine the weapons offered for this purpose, consisting of Albert D. Shaw, Robert H. Thurston and E. W. Bliss. The gun is the invention of Mr. Arthur W. Savage, Supt. of the Utica Electric Ry. Co., and is manufactured by the Savage Arms Co., of Utica. Its magazine holds five cartridges which are held in a magazine similar to a revolver cylinder, so that there is no possibility as in the tubular magazine of a cartridge being exploded by the impact of the one behind it against its primer. There were twelve guns in the competition, and the Krag-Jorgenson and Lee-Metford weapons, the new standards of the U. S. Army and Navy, respectively, were also tested, but were found inferior to the Savage gun. Under the law providing for the selection of a new weapon, the Adjutant-General of the state of New York is authorized to contract for 150,000 of the new rifles, at a price not to exceed $20 each.

NO MORE HIGH SMOKESTACKS are to be used on the U. S. naval vessels. The high stacks on the "Brooklyn" and "Iowa" were adopted by Engineer-in-Chief Melville to increase the draft and lessen the use of the forced draft. The line officers, however, are said to oppose the high stacks, on account of their appearance, and consequently they will have to go.

HEAVY ORDNANCE is being placed in position to command the entrance to New York harbor. At Willit's Point, L. I., the work of mounting two of these large guns is in progress. They are 30 ft. long, 10 in. bore and weigh 30 tons each. The steel projectile weighs 575 lbs. and requires 250 lbs. of powder. Each gun can be fired at intervals of three minutes. After the discharge the guns disappear behind the parapet for reloading. In practice shooting the target is to be set six miles away.

SYSTEMS OF FIRING HIGH EXPLOSIVES with safety are to be tested by the naval ordnance bureau, according to Washington press despatches; and it is stated that $50,000 is available for carrying out the tests. Devices are invited from inventors both in and out of the service.

THE HASKELL MULTI-CHARGE SYSTEM is again to be tested, the Board of Ordnance and Fortifications having furnished funds sufficient to give the gun a test of 20 rounds. The gun to be tested is of 8 ins. caliber and has two auxiliary powder chambers attached to the lower side of the barrel. The 6-in. gun of this type which was tested some years ago and proved a failure was provided with four auxiliary powder chambers.

COMPLAINTS OF EXCESSIVE CHARGES for the transfer of grain from lake vessels to canal boats at Buffalo, and from canal boats to elevator or vessel at New York, are again made by the canal boatmen. In an appeal to the New York Produce Exchange the canal boatmen of Buffalo say:

> The result of such unjust methods on the part of the railroad and the wharf trust has been the accumulation of nearly 400 canal boats at this port, or nearly half of the entire diminished canal fleet is here to-day, unable to obtain cargoes at the low rate of 3⅝ cts. a bushel on wheat, 3½ cts. a bushel on corn and 2⅝ cts. a bushel on oats to New York, out of which we, the canal carriers, must pay trimming, tugging, insurance on cargo and scalpage here, Hudson River towing, wharfage and trimming cargo at New York; also we must make good the shortage in cargo. After these deductions it leaves us about 2⅛ cts. a bushel net on wheat to run and man our boats. If we are lucky we will obtain a west-bound cargo to Buffalo at 45 cts. gross ton, free in and out. If we cannot secure an up-freight we are compelled to come to Buffalo light. On the other hand, the charge for transferring grain direct from the lake vessel to canal boats at Buffalo is 1 3-10 cts. a bushel, and for like service at New York it is 1 5-10 cts. a bushel, or, at both ports the extortion amounts to 2 8-10 cts. a bushel, or a clean gouge at both ports of plump 2 cts. a bushel against canal grain, if the grain is stored on its way to the world's markets, the extortion doubles up in short order. Contrast this robbery with the next-to-nothing terminal charges at the railroad docks of New York's fierce competitors and who can wonder that the trade that legitimately belongs to New York is like water seeking the lowest level, not to say anything about the full cent-a-bushel differential railroad rate against your port? The result of this gigantic railroad conspiracy against New York and New York's canal is to keep boats here in idleness from fifteen to twenty days waiting for cargoes, while at the same time competing railroads are flooded with grain. It may be truthfully stated that about all the grain and other freight that the canal and New York get is that portion that slops over the railroad grain elevator dams, as aforesaid.

It must be confessed that a charge of 1.3 cts. a bushel for transferring grain from a steamer to a canal boat does look a little steep compared with a net rate of 2⅛ cts. a bushel for carrying the same over 400 miles of canal and river navigation.

SHIPMENTS OF GRAIN from Buffalo to New York by rail and canal respectively are reported as follows for the period from May 1, the opening of navigation, to July 2, this year and last year.

1896.	Wheat.	Corn.	Oats.	Total.
By rail, bushels.	3,605,900	5,453,350	6,672,200	15,732,050
By canal, "	4,332,700	583,100	4,190,000	9,105,800
1895.				
By rail, bushels.	2,943,350	4,607,850	3,383,200	10,934,400
By canal, "	1,514,000	110,400	2,440,200	4,064,600

It will be seen from the above that the canal is carrying, so far, over twice as much grain as a year ago. It will be remembered, however, that the shipments by canal in the early part of last season were phenomenally small.

THE EXPORTERS' ASSOCIATION OF AMERICA is the title of an organization recently formed to co-operate in securing foreign markets for American manufacturers. I's officers are: President, Addison H. Nordyke, President of the Nordyke & Marmon Co., of Indianapolis; Vice-President, Jas. W. Cooke, New York city; Treasurer, A. M. Dolph, President American Laundry Machinery Co., Cincinnati, O. The headquarters are in the Morris Building, New York city, with Mr. Andrew H. Power, the secretary of the association, in charge. All responsible manufacturers and exporters and foreign buyers are eligible. The dues are $100 per year. Members have the privilege of using the association's rooms as headquarters while in New York, receive weekly reports of exports of goods in their line, and reports of financial standing of firms in foreign countries when requested, and have the consular and custom-house work in connection with exports attended to. The members of the Board of Governors besides the officers named above are C. H. Hutchins, President of the Knowles Loom Works, of Worcester, Mass.; A. H. Overman, President of the Overman Wheel Co., Chicopee Falls, Mass., Carl F. Lunkenheimer, Treasurer of the Lunkenheimer Co., Cincinnati, O., and others.

AMERICAN BICYCLE MAKERS are cultivating the export trade assiduously of late. In the month of May the value of bicycles and bicycle parts exported was $220,176.

THE MOST SERIOUS RAILWAY accident of the week and of many weeks occurred near Logan, Ia., July 11, on the Chicago & Northwestern Ry., and was a head collision at a curve between an excursion train and a fast freight. From press reports it appears that the excursion train left Logan without orders. It was running very slowly when struck by the freight, whose speed was about 30 miles per hour. The baggage car was driven back through the first coach, killing or injuring almost every one in it. Passengers in the other coaches were not hurt. Thirty-three persons were killed and 37 were injured. On July 12 an excursion train on the Chicago & Northern Pacific, at Altenheim, Ill., ran into an open switch and collided with two freight engines standing on the switch; five persons were killed and six were injured. As in the Logan disaster, the baggage car telescoped the first coach. This coach was a light one used ordinarily for suburban traffic. Had it been as heavy as the remaining ones, there would probably have been no serious results, as the train was running so slowly that passengers in the rear cars did not realize that a collision had occurred.

At Wilkes Barre, Pa., on July 13, an express train on the Lehigh Valley Ry. while rounding a curve struck a cow. The train was derailed and the locomotive rolled down a high embankment; three passenger coaches were thrown upon their sides; one person was killed and 19 were injured. The derailed train is stated to have run over 200 yds. on the ties.

AN ELEVATOR ACCIDENT occurred in an apartment house at Adams and Dudley streets, Boston, Mass., July 10; workmen in the building had been accustomed to let themselves down governing the elevator by the brake after steam had been turned off. At the time of the accident 13 men crowded into the car when it was 60 ft. from the ground; the brake refused to work and the car fell the entire distance. All those in the car were injured.

ACCIDENTS ON THE BROADWAY CABLE RAILWAY, at the 14th St. curve, in New York city, have attracted much attention of late. The company has always run its cars around this curve at the full speed of the cable, claiming it was impossible to slacken the grip while the car was rounding the curve. So many accidents have resulted and so much public complaint has been made, however, that the company proposes, it is said, to introduce an auxiliary cable to operate cars on this curve. The Board of Aldermen has an ordinance before it limiting the speed on curves to four miles an hour.

THE TIDAL WAVE which visited the coast of Japan on June 15, appears from the fuller accounts now at hand to have been even more destructive than at first reported. The number of lives lost may be placed in round numbers at 30,000. The United Press correspondent at Tokio on June 26, stated that the totals had then reached 29,073 killed, 7,737 wounded, and 7,844 houses washed away or wrecked. It is an excellent showing of Japan's progress in civilization that it should be possible to obtain such detailed figures of the extent of so great a calamity. The cause of the tidal wave appears to have been some earthquake or volcanic eruption beneath the sea at some distance off the Japanese coast. While this occurrence ranks among the greatest disasters of modern times, its record of fatalities is not the largest, as has been claimed by the daily press, but is exceeded by the loss of life due to the breaking of the levees of the Yellow River in China in 1887, and we believe by some others. An interesting summary of great disasters was given in our issue of July 6, 1889.

THE RUNAWAY OF AN ELECTRIC CAR, on a steep grade on 39th St., Brooklyn, on June 7, last, has been reported upon by the New York Railroad Commission. The board recommends that passengers be prohibited absolutely from riding on the running-boards or side steps of open cars and that all cars operated over grades steeper than 5% should be equipped with some sort of auxiliary brake, and in ascending such grades, conductors should be required to remain on the rear platform to protect the trolley pole or assist at the brakes, in case of emergency. The board appears to have overlooked the fact that if such a rule is put in operation it should apply as much to cars descending such grades as to those climbing them. There is much more danger in coming down a long or steep grade than in going up it.

WATER POWER DEVELOPMENT at Garvin's Falls, N. H., 13 miles from Manchester, is proposed. At this point the Merrimac River falls 30 ft., and with proper storage 4,500 HP. is said to be available. Among those interested are W. A. Russell, J. M. Wheaton, W. A. Tucker and Philip Y. Saltonstall, of Boston.

THE EXTENSION OF THE WHEEL PIT of the Niagara Power Co. at Niagara Falls, was begun on July 9, and will be prosecuted by double shifts until completed.

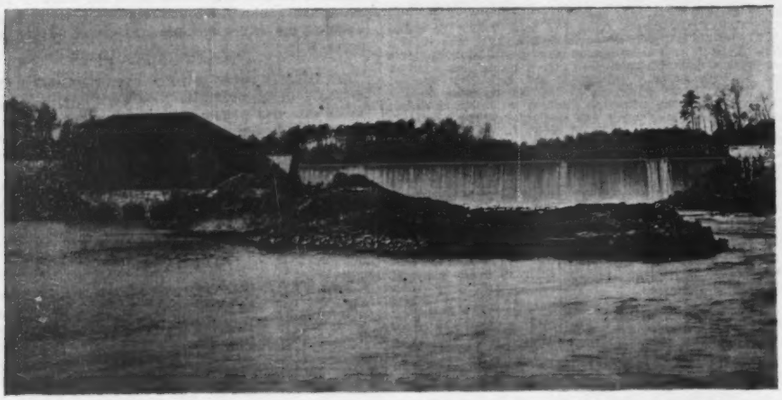
THE CLIFF PAPER MILL at Niagara Falls, illustrated in our issue of March 26, began running on July 11, with electric power developed by the water-wheels and generators in the power house at the base of the cliff.

TESTS OF A BOILER of the Cahall vertical water-tube pattern were made at the works of the Armstrong Cork Co., Pittsburg, Pa., on May 4 and 5, by Thos. H. Pray, Jr., of 95 Milk St., Boston. The boiler was rated at 250 HP., and notwithstanding that it was run on the first day 5% above its rating, and on the second day at 60% above, the steam in both cases showed a large amount of superheating, 46° on the first day and 26° on the second day. The evaporation from and at 212° per lb. of combustible on the first day was 13.9 lbs., and on the second day 11.7 lbs. Pamphlets containing the detailed figures of the tests will be sent on request by Messrs. H. E. Collins & Co., of Pittsburg, Pa.

THE BIDS FOR A NEW WATER SUPPLY FOR Jersey City, submitted recently by the Rockaway & Hudson Water Co., is reported as about to be formally rejected. It is said that bids will again be called for soon. If this is done it will be the fifth or sixth call within the past four years.

ELECTRIC TRANSMISSION OF WATER POWER AT PELZER, S. C.

The accompany views show a large water-power plant recently installed for the Pelzer Mfg. Co., of Pelzer, S. C. The plant is located on the upper Saluda River, in the western part of the state. The power house contains five pairs of 39-in. horizontal Victor turbines each pair coupled direct to a 1,000 HP. generator and regulated by a Giesler electro-mechanical governor. The electric current which is thus generated is transmitted to the cotton mills of the corporation, located about 3½ miles away. The electrical transmission was installed merely for the sake of locating the factory on the most eligible site. It was deemed cheaper to carry the power to the factory than to choose a less favorable location for it. The dam and power house were built by W. A. Chapman & Co., of Providence, R. I.; the electrical machinery was furnished by the General Electric Co., and the turbines and other apparatus for the water-power development by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, O.



DAM AND POWER-HOUSE FOR WATER POWER DEVELOPMENT WITH ELECTRIC TRANSMISSION AT PELZER, S. C.

BURNSIDE SHOPS, ILLINOIS CENTRAL R. R.

(With inset.)

II.

Locomotive Shops.

In the article describing and illustrating this notable railway shop plant, published in our issue of June 18, the ground constructions, minor buildings, and the smallest group of main buildings were considered. In the present article we take up the construction of one of the larger groups of buildings forming the locomotive or metal-working shops. Each building will be described in such detail as the importance of its structural features may seem to warrant. The buildings devoted to locomotive and metal-work are three in number, viz.: a machine shop, blacksmith shop, and roundhouse, and are all located to the south of the oil house, store house and boiler house. All of these buildings were built in 1892 except the blacksmith shop addition, 254 1-6 × 110 ft., which was built in 1895.

Machine Shop.—The machine shop is 552 ft. 2 ins. long and 160 ft. 3½ ins. wide out to out of walls, and is covered by a double roof, as shown by the cross-section Fig. 12. Fig. 13 is a diagram plan of one end of the building, and is inserted to aid in explaining the character of the construction. The opposite end of the building is exactly the same. Turning to Fig. 12 it will be seen that two triangular trusses cover the building. The outer ends of these trusses rest on the side walls and the inner ends on a row of columns which extend lengthwise down the middle of the building. Details of the roller bearings at the wall ends and the inner end truss bearings are shown by the drawings. The west half of the building is open to the roof, and is designed to have an overhead traveling crane. It is into this half of the shop that locomotives from the transfer table are run for repair, there being a series of 24 transverse tracks, each with its pit between rails, for this purposes. The east half of the building is given up to machine tools and machine work, and there is overhead the framework shown by Figs. 13 and 14, which was designed to be floored over, except in the center, and to be used for lighter kinds of work, when the demands of the company should require greatly increased plant, but at present it is used to carry the shafting, a small crane, air hoists, etc. The various parts of this framing and their purposes can be ascertained by inspecting the reference letters and titles in Figs. 12, 13 and 14.

The structural features of the machine shop having been explained, attention may be turned to the equipment for doing work. The power generators may be taken up first. These consist of engines and dynamos, and are all located in a small attached building or annex on the east side of the shop. There are in this building one 200 HP. Bullock-Corliss engine for running the shafting from which all machinery is driven; one 150 HP. and one 50 HP. Buckeye engine, and one 100 HP. Ideal engine. These three smaller engines are used to drive two 80-light and one 40-light arc dynamos and two incandescent light dynamos, operating about 1,000 16-c. p. lights.

To enumerate the various tools used would be of little value, and all that need be said is that the equipment is ample for constructing and repairing all classes of machine work for locomotives and cars. To handle material there are hand and power cranes of various sorts, air hoists, and push cars and trucks. The air for the hoists is obtained from the mill building power house, as will be described further on. All machine tools are located in the east half of the building, and the erection is done in the west half, which is open clear to the roof. Facilities for the erection of 24 engines at one time are available.

Blacksmith Shop.—Under the roof of the large blacksmith shop building, which covers an area of 71,960 sq. ft., are a wood working shop, a boiler shop and the blacksmith shop proper. The main building, 440 ft. long and 100 ft. wide, runs north and south, and the addition, 254 ft. 2 ins. long and 110 ft. wide, joins onto the north end and extends west. Beginning at the south end of the main building the first 100 ft. in length is used as a wood working shop for locomotive wood work. A wooden partition extends transversely across the building and divides the wood working shop from the boiler shop, which takes up the next 200 ft. of the length of the main building. At the north end of the boiler shop is a brick partition, and beyond this the main building and the addition or the blacksmith shop proper.

The structural features of interest in this building are confined principally to the roof trusses. Owing to fear of delay in securing steel the trusses for the main building were made of wood, and of the design shown by Fig. 15. The main or center truss has a span of 51 ft., and is carried on cast-iron columns, extending in two rows lengthwise of the building, and 25 ft. 9 ins. from the outer walls. Between these two rows of columns and the outer walls the space is covered by steel trusses. A raised cupola, with side lights, runs the entire length of the wood-working and boiler shops, but over the blacksmith shop the skylight is replaced by ventilators for obvious reasons.

The interior arrangement of the boiler and wood shops calls for but little mention. Entering them from the east side are a series of tracks, which are connected with the locomotive transfer table. Between the interior rows of columns carrying the main roof truss are longitudinal, wooden trusses, designed for a traveling bridge crane, and there are also various cranes and jacks located at different points where needed. The power to operate the machinery is supplied by a 100 HP. Westinghouse standard engine.

The blacksmith shop addition is of later construction than the main building, and the character of its roof construction is entirely different, as is shown by the general plan and elevations in Fig. 16. These drawings show the design and construction in sufficient detail with the exception perhaps of the connection details between the old and new buildings. Across the end of the

HORIZONTAL TURBINES IN POWER HOUSE AT PELZER, S. C.

old building extends a plate girder carried by the side walls and two intermediate columns, which supports two of the roof trusses of the addition and also the brick end wall of the old building, as shown by Fig. 17.

The interior arrangement of the blacksmith shop addition calls for no particular mention.

Round House.—The round house is a ring-shaped building, 316 ft. outside diameter and with a circular interior court 166 ft. in diameter, in which is located the locomotive turn table. Forty locomotives can be stored in the building at once. The walls are of brick and the roof is carried by wooded trusses which have no features demanding particular mention.

The foregoing description with the illustrations give the essential structural features of the locomotive shops of the Burnside plant. The drawings should be studied in particular since care has been taken to avoid repetition of information given by them in the descriptive matter. In a succeeding article the car shops will be described in detail.

For the information from which this article has been prepared we are indebted to Mr. John F. Wallace, M. Am. Soc. C. E., Chief Engineer, and Mr. H. W. Parkhurst, M. Am. Soc C E, Engineer of Bridges and Buildings, Illinois Central R R.

A SMALL ASPHALT-LINED RESERVOIR AT INDIO, CAL.

By J. B. Lippincott.

There is a small asphalt-lined reservoir at Indio spurr, four miles east of Indio station, which is in the Colorado desert west of Yuma. Its length is 88 ft., and its width is 48 ft. on top, and its depth is 4 ft. Its inner slopes are approximately 30° from the vertical, or steeper than 1 to 1. It was built in 1892 under the general direction of Mr. Sutherland Hutton, an asphalt expert and contractor, of Los Angeles, Cal. The sides and bottom were made of asphalt concrete, 3 ins. thick, which was tamped into place while hot with irons. The sides are floated with a coating of asphalt and carbonate of lime, approximately ⅛-in. thick. The sides would have been better with more slope, 2×1 being preferable. An earthen bank was made from the material excavated, 4.5 high and 4 ft. wide on top, with an outer slope 1½×1, the material being sandy loam.

Arroyo Grande (San Louis Obispo) asphalt, 76% pure, costing $25 per ton in 1892 (now $15), was used. It was fluxed with 40% "G grade" asphalt (costing $14 per ton), refined from maltha which will stand 350° flash test. The asphalt concrete, "because of the absence of sand in the locality," was mixed in Los Angeles, the proportions being: Asphalt, 15%; sand, 20%; gravel, 65%. It was cast in blocks, shipped, reheated, laid on this earthen bank and tamped into place behind boards or wooden forms.

Further experience in making asphalt concrete is said to indicate that a much smaller percentage of asphalt should be used, good concrete having been made with as low as 5% of asphalt. Enough asphalt should be used to make a bond in the material and no more, large amounts making the concrete soft under high temperatures. The ideal should be perfect mixing and a low percentage of asphalt.

The writer has seen concrete that was said to have been made of 5% of asphalt and of sand with quartz and granite pebbles of from ½ to 1 in. diameter, in which, under the hammer, the pebbles would go to pieces before the bond would yield. The surface of the concrete in this reservoir was floated with a composition of asphalt and carbonate of lime. The greatest skill and care has to be used in this portion of the work. If the liquid asphalt is heated to too great a temperature it will crack, and if not high enough it will run. The requisites of each case have to be considered and the heat adjusted to them. The liquid asphalt on the side has done some running, but it was found that the sand which was drifted by the lodging on and adhering to it stiffened it and held it in place, which would suggest that a sand blast applied to asphalt coating while it was still hot would not interfere with its imperviousness and would keep it from running.

This reservoir, which is uncovered, has stood temperatures in the shade of 123° for several days, and as the reservoir is emptied every other day, the entire asphalt coating is alternately exposed to and shielded from the direct rays of the sun.

At the ends of the boards or forms, where the concrete was joined to the next abutting layer, cracks of considerable size appeared, which were closed with the liquid asphalt. Coarse grass grows with considerable vigor through the concrete, giving trouble. Since first constructed, this reservoir has never been repaired, has been in constant service and has not leaked. It was built for Mr. C. H. Gale, of Indio. It is filled from two 500-ft. artesian wells, with 5 and 8-in. casings, respectively. Its capacity is about 84,000 gallons, and it is used in irrigating 10 acres of land.

The following is a statement of cost:

Prepared asphalt concrete, 40 tons (2,000 lbs.) at $8.	$320
Freight on above	140
Labor	140
Plant (kettles, etc.), not valued	....
Dressing after laying	100
Total cost	$700

The total area of the asphalt concrete was 4,700 sq. ft., making the cost 14.9 cts. per sq. ft.

A PROPOSED STANDARD SPECIFICATION FOR PORTLAND CEMENT.

An interesting paper has recently been prepared by Mr. Wm. J. Donaldson, of Philadelphia, the object of which is to urge the adoption by the United States of a standard specification for Portland cement, the use of which should be required on all work done under the direction of officers of the corps of engineers, and also by the Navy, the Supervising Architect's Office, etc.

Mr. Donaldson sums up present conditions as follows:

1. Lack of uniformity.—The specifications now in use on the various branches of government work show that they have been drawn up by the different engineers in charge of the various departments; with few exceptions they show great difference as to requirements for strength, which is one of the essential features. Some specifications advertise brands alone, without specifying any requirements. The majority of specifications call for no tests on the stability or, in other words, the constancy of volume; few provide for tests on mortar—sand with cement—one of the most vital considerations in determining the true value of cement. The neat tests appear to govern those specifications in which a requirement is asked for; a test which accepted authorities have rendered obsolete and of little value. Slight consideration is taken of fineness, upon which the cost of work largely depends.

2. Low requirements.—Considering first the question of fineness, where such provision is made, in the majority of cases the No. 50 sieve, containing 2,500 meshes per sq. in., appears to represent the standard. Some few specify the No. 100 sieve, containing 10,000 meshes per sq. in., but in all of which the provisions for the minimum percentage of residue asked for, appears to have been taken from specifications made years ago, long since fallen into disuse. As to the strength, some specifications for Portland cement call for minimum tensile strength equalled and surpassed at the present time by the best American natural cements, while the highest provide for a strength far below the performance of the best brands.

3. Acceptance based largely on commercial reputation of brand.—Where brands are specified, the policy followed appears to be a selection of some brand or brands, which have been manufactured for some years—usually foreign cement—in which case two or more brands of Portland cement of entirely different quality are found side by side. Where provision is made for the substitution of other brands, their acceptance is based on their equality, in which the standard of quality is not defined, and unjustly left to the discretion of the engineer.

He then presents his reasons for the adoption of a standard specification by the government, and instances as an example the standard specifications adopted on the Continent of Europe by the congress of cement testing laboratories of Germany, France, Austria, Belgium and Switzerland. The following are the specifications proposed by Mr. Donaldson for adoption as standard. It will be noticed that they are exceedingly full and detailed, and are unique in that the method in which the tests shall be made is fully laid down:

Quality.

Cement.—All cement used to be well seasoned Portland cement, and must conform to the following requirements and be capable of passing the tests herein specified. Manufacturers to guarantee that all cement has been seasoned, or subject to aeration at least 30 days before leaving the works.

Manufacturers to furnish certified tests, from their laboratory, on every car load when shipped; such tests to show they pass the stated requirements, but which shall in no wise be a guarantee of acceptance by the government. This provision acting only as a guide to the cement manufacturer, as acceptance or rejection of cement will be made on government tests.

Packing.—Cement to be packed in strong and well coopered barrels, 400 lbs. gross, or in strong cotton duck bags, three or four bags to the barrel, and 380 lbs. of cement to the barrel.

Sampling.—Samples to be drawn from at least 10% of every one 100 barrels received, the government reserving the right to sample every barrel. Samples to be drawn from the interior of barrel or bags by an iron tube (after the pattern of a molasses gager), and thoroughly mixed as one sample. Tests to be made from the average sample taken from 10 barrels, representing the lot of 100 barrels sampled. Acceptance or rejection to be made as the tests meet or fail to meet the requirements.

Chemical composition.—Full chemical reports to accompany each shipment, the government reserving the right to analyze every sample taken, which must conform to the following requiremnts, and be a tri-calcic silicate cement:

Lime	62 to 66%
Silica	20 to 22%
Sesquioxide of iron and alumina	8 to 12%
Magnesia	not over 3½%
Sulphuric acid	not over 2%, for slow setting cement.
Sulphuric acid	not over ½ of 1%, for quick setting cement.

Time of setting.—A cake of neat cement to be moulded on glass to determine time of setting:

Slow setting, initial set to be over 30 minutes.
Final set to be not over 12 hours.
Quick setting, final set to be not less than 30 minutes.

Slow setting cements to be used in all cases, except for submarine work and in places where water and tides interfere with slow setting cements.

Fineness.—Cements to be of such fineness that 95%, by weight, shall pass through a No. 100 sieve, having 10,000 meshes per sq. in.; 80%, by weight, shall pass through a No. 200 sieve having 40,000 meshes per sq. in.

Checking and cracking.—Two cakes of neat cement to be molded on glass. One to be immersed in cold water, after having set hard, and examined from day to day for surface checking and warping. The other, after having set hard, to be immersed in water at 212° F., and allowed to remain in the water at that temperature for 24 to 36 hours. Examination to be made of the pat at the end of that time for constancy of volume and checking. Should the pats become contorted, or show signs of cracking or warping, the cement will be rejected.

Specific gravity.—The specific gravity shall not be less than 3.00.

Tensile strength.—Neat briquettes shall stand a minimum tensile strain per sqare inch without breaking:

12 hours in air and 12 hours in water....200 lbs.
1 day in air and 6 days in water.....500 "
1 day in air and 27 days in water.....650 "

Sand, mortar briquettes, 3 parts of sand (No. 4 standard crushed quartz) to 1 of neat cement shall stand a minimum tensile strain per square inch without breaking:

1 day in air and 6 days in water.....150 lbs.
1 day in air and 27 days in water.....250 "

Manner and Method of Testing.

All Portland cement will be tested according to the following manner described:

Sample.—When the sample is received, carefully mix in a suitable vessel to thoroughly distribute the coarser particles and make it more uniform.

1. Setting.—Mix 100 grammes of neat cement with the correct percentage of water, previously ascertained. Mold the same on a piece of glass 4 ins. square, making the centre of the pat about ½ in. in diameter, and drawing the mass down to a fine edge on the glass; the whole pat assuming a circular shape. When the surface of the cement will sustain a weight of ¼ lb. supported on a wire 1-12 in. in diameter without making any impression, the difference between this time and the time of making is the initial set.

Final set.—When the surface of the cement will sustain a weight of 1 lb. on a wire 1-24 in. in diameter without making any impression, the difference between this time and time of making is the final set.

Fineness.—Pass 100 grammes of cement through a No. 100 and No. 200 standard brass gage sieves (containing, respectively, 10,000 and 40,000 meshes to the square inch). The weight of each residue gives the percentage of fineness of the cement passing through these sieves.

Hot and cold water test.—Mold two pats of neat cement as heretofore described under setting. Allow same to set in air (covered with a damp cloth to prevent surface drying) for 24 hours.

Immerse one in cold water, and allow it to remain in water for an indefinite period—for at least seven days—examining it, from time to time, for warping, checking and cracking.

Immerse the other pat in water 212° F., and allow it to remain for 24 hours in the water at the same temperature; at the end of which time remove the pat and examine for disintegration and constancy of volume.

Mixing and gaging.—Never mix more than a sufficient quantity for one mold, when the initial set is under ten minutes, using 150 grammes of neat cement for each mold, with the addition (at one time) of the proper percentage of water previously determined. Mix and knead the cement thoroughly by hand, using rubber gloves as a protection, and afterwards troweling it in order to bring it to a fine edge, and causing it to shed water. After being thus thoroughly worked until the mass is homo-

genous, proceed to fill the molds, having first wiped the inside with an oily cloth, in order to prevent sticking, and laying them on a flat smooth piece of slate. Press the cement in with the thumbs, being careful to allow no air bubbles in the cement. Having filled all the molds, smooth them off with a spatula or trowel upon which a slight pressure is exerted.

In the case of neat cement, do not turn or move the moulds from the table after the cement is put in, as the under side will present a smooth surface similar to the upper, if a perfectly smooth surface is used to lay the moulds on and the cement has been carefully pressed in. Cover the briquettes with a damp cloth, immediately after molding, in order to prevent rapid surface drying and to cause a uniform set.

For 24 hour neat test, remove filled molds from slab as soon as set and stand on ends without covering of damp cloths, for 12 hours. Then remove briquettes and immerse in water for the balance of the 24 hours.

For 7 or 28 day tests, remove briquettes from molds at the end of 12 hours, and allow them to remain under a damp cloth for the balance of the 24 hours; then immerse in water for 6 days or 27 days. Then break them in a good testing machine, such as Riehle's or Fairbanks'.

Sand briquettes.—In the case of sand briquettes weigh out 600 grammes of sand and 200 grammes of cement, and mix dry in a pan, add half the percentage of water ascertained in the neat test. Mix this mass well on a slate slab, to thoroughly incorporate the sand and cement, using a trowel for this purpose. This complete mixing is very necessary in the case of a finely ground cement. Care should be taken that the mortar does not become too dry during the manipulation; if it does, dip the trowel in water, which will be sufficient to keep it moist. Having thus mixed it well, press it into the molds, previously arranged as in the case of neat cement. Smooth and trowel the top and bottom of the briquettes, turning them carefully for this purpose, in order to bring the moist cement to the surface, thus filling the voids and making both sides of the same degree of smoothness. This will prevent one side from being more absorbent than the other when immersed.

For 7 or 28 day sand mortar test, remove the briquettes from mold at end of 12 hours and place under damp cloths, immersing them in water at the end of 24 hours (the same as in the neat tests for like periods of time) for 6 days or 27 days, respectively, as the requirements may be.

Sand.—Sand used should be standard crushed quartz, No. 4, capable of passing a No. 20 sieve and caught on a No. 30 sieve (sieves, standard brass gage, having 400 meshes and 600 meshes to the square inch, respectively).

Water.—Water used for tempering and gaging, as well as for the immersion of briquettes, should be clear, and between 65° to 70° F.

Notes.—When mixing rapid setting cements care should be taken that the initial set does not take place before molding; if it does, the mass should be rejected. Care should always be taken to keep the briquettes completely submerged in the water while immersed, and make the test as soon as they are removed from the water. Stand the briquettes on end while immersed in the pans, so that the maximum surface will be at all times exposed to the water.

Mark on each briquette a number, same referring in some suitable record book to brand, days of making, tesing, breaking and full tests and properties of cement.

The advantages to be derived from uniform specifications and manner of testing such as advocated are enumerated by Mr. Donaldson as follows:

1. A standard system applicable alike for all departments.
2. Knowledge of the proper and economic use of Portland cements.
3. Higher standards and consequent rejection of inferior brands, due to an accurate system of tests.
4. All cements placed on an equal footing and merits determined.
5. Incentive to the betterment of quality.
6. The fostering of an American industry.

In conclusion, Mr. Donaldson presents some argument for the above specifications which are worth careful consideration. He urges that present specifications are defective in not insisting on fine grinding. The residue on a 200 sieve, he states, is of no more value than so much sand, as it has no setting properties, and in comparing the price of different cements, it should be remembered that it is only the fine portion that is of value; one cement may be nominally more expensive than another and yet be actually the cheaper, on account of its smaller percentage of unground particles. The improvements in grinding machinery during the last few years have made it possible to grind cements finer than formerly, at slight increase of expense, so the engineer need not be deterred from insisting on finely ground cement by reason of extra cost.

Another important point raised by Mr. Donaldson, is the advantage of shipping cements from the works to the place of use, in bags instead of barrels. It is exceedingly common to see in specifications a clause inserted requiring the cements to be shipped in casks; when, if the engineers only knew it, it is better to have it shipped in bags. The cement is thus more perfectly seasoned; it can be more readily and cheaply handled; and the manufacturer can afford to sell it at a materially less figure, as the bags are returnable, and are used over and over again. In other words the purchaser of the cement gets a better article at a less price.

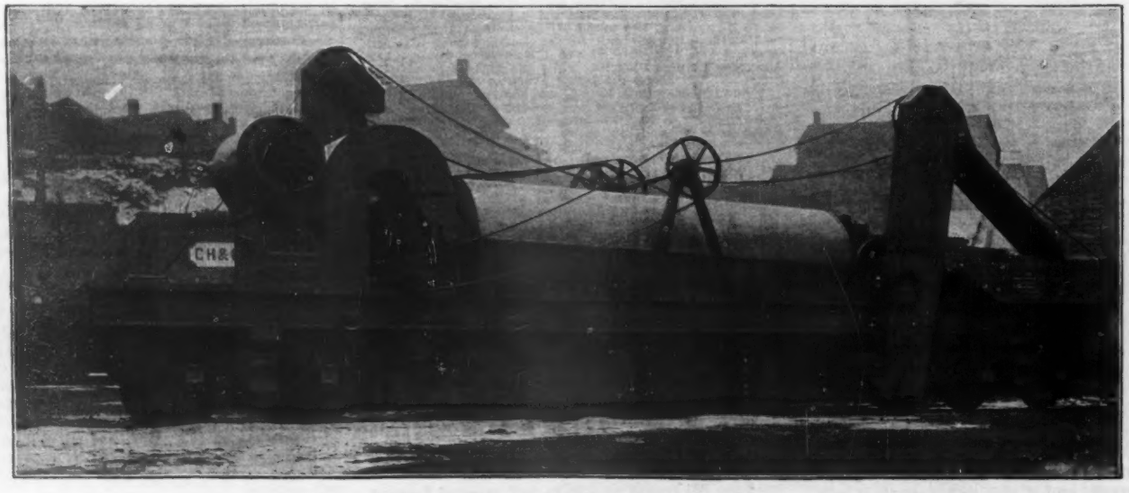
A PORTABLE DRYING AND HEATING PLANT.

We show herewith an invention of much practical interest in many industries. It is a drying and heating apparatus mounted on the trucks of a standard railway car, so as to be easily moved from place to place, and adapted for drying and heating sand, crushed stone, or other materials on a large scale, and with great economy and efficiency. The plant was designed and built by the F. D. Cummer & Son Co., of Cleveland, O., and consists of an all-steel car frame, 48 ft. in length and 9 ft. 3 ins. wide over all. On this is set a Cummer, style A, patent dryer and heater, with a 25 HP. Westinghouse engine and the necessary elevating and power transmitting machinery.

The firebrick about the dryer is so secured, we are informed, as not to be likely to crush or loosen under the shocks and jars experienced on the road, and the lowest point of the dryer has more clearance above the rails than a locomotive pilot. The car has M. C. B. couplers and Westinghouse air brakes, and has been examined and accepted by the railway officials for transportation.

Two elevators are used in connection with the dryer, as shown, one feeding the drier, and one delivering the dried and heated material to the screen or to any point desired. The operation of the apparatus is easily regulated, and the material heated can be delivered dried and uniformly heated to any temperature from 150° to 600° F.

The cut herewith is reproduced from a photograph of a drying plant recently built for a large asphalt paving company. The apparatus shown will dry and heat about ten tons of sand per hour.



PORTABLE DRYING AND HEATING APPARATUS.
Designed and Built by the F. D. Cummer & Son Co., Cleveland, O.

LOW LEVEL BRIDGES IN QUEENSLAND.

Australia is a country famous for its alternations of drought and flood. Water courses which, in the dry season, shrink till they almost disappear, are converted by sudden rains into broad, deep rivers, which subside, however, as quickly as they rise. To carry highways across these streams by bridges at a level above the highest floods is a very expensive task, as high piers or long spans are required and iron or steel bridges are expensive. Moreover, as is well known, the greater part of the country is sparsely inhabited, and the traffic will not warrant great expense in the maintenance of highways.

To meet these conditions, the Australian engineers have in some case adopted what are known as low-level bridge. Instead of building a bridge above high-water mark, they make it high enough, merely to clear the water surface at moderate floods, and permit the higher floods to submerge it entirely, considering it better to suffer the inconvenience of a stoppage of traffic during the short time that these higher floods last than to go to the expense of a high-level bridge.

Of course the low-level bridges are especially designed to resist the force of the current of water when submerged; but, on the other hand, they are not subject to danger by drift piling up against them and forming a dam, as the debris is not carried down a river in considerable quantity until a stage is reached at which a low-level bridge would be submerged.

A paper describing some of these low-level bridges was recently read before the Institution of Civil Engineers, by Mr. A. B. Brady, M. Inst. C. E., of Brisbane, Queensland, and we reprint the substance of it as follows:

Herbert River Bridge, Garloch.

The level of the decking of this bridge is 10 ft. above high water of ordinary spring-tide, or 29 ft. below the highest flood-mark. The bridge has a total length over the abutments of 481 ft. 3 ins.; and consists of 14 spans

of 33 ft. each, the clear width of roadway between the curbs being 16 ft.

The piers, 13 in number, together with the abutments and wing-walls, are built of Portland cement concrete composed of one part of cement, three parts of clean sharp river-sand, and six parts of hardstone broken to 2-in. gage. The string-courses under the steel superstructure were formed of a stronger concrete composed of one part of cement, two parts of sand, and three parts of hardstone broken to 1½-in. gage. The pier foundations were laid on rock at depths varying between 4 ft. 6 ins. and 6 ft. below high water, temporary wrought-iron caissons, constructed in sections bolted together having been used. The maximum depth of sand overlying the rock-bottom was 4 ft. 6 ins; and the maximum depth of sinking in the rock 1 ft. 6 ins. Each pier has semi-circular ends with a batter of 1 in 12 above the plinths; the batter of the sides, between the splayed plinth and the underside of string-course, being 1 in 24. All exposed faces of the concrete in the piers and abutments were floated with a mixture of one part of Portland cement to two parts of sand.

The superstructure or decking of the bridge was formed of mild-steel or trough-plates 12 ins. in depth, weighing 25.82 lbs. per sq. ft. of area covered. The plates were

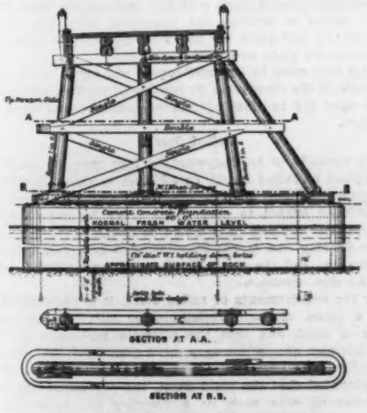


FIG. 1.—THE HERBERT RIVER BRIDGE, GAIRLOCH.

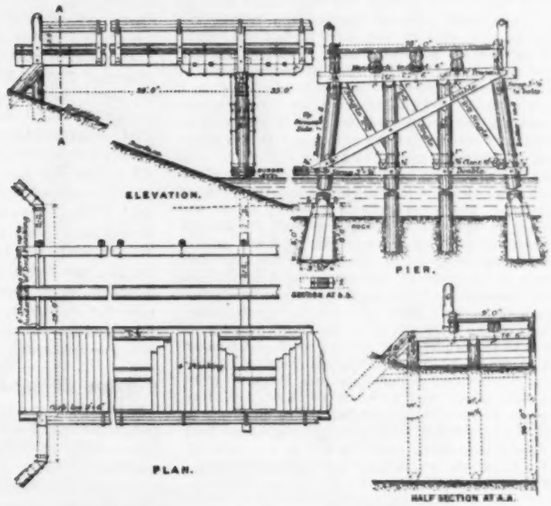


FIG. 2.—THE BALONNE RIVER BRIDGE, ST. GEORGE.

Fig. 3.—The Mary River Bridge, Tiaro.

cambered to the extent of ¾ in. at the centre of each span, and the sections riveted together with ⅝-in. rivets at 6-in. pitch throughout. The trough form of superstructure possesses many advantages for short spans, as girders may be entirely dispensed with, and, in the case of low-level bridges, the small depth of the troughs offers but little resistance to the passage of flood-waters during the wet seasons. The whole of the steel-work received three coats of tar. For securing the steel superstructure to the piers and abutments, 1-in. lewis-bolts were fixed in the concrete string-courses, the upper surfaces of which were trowelled smooth and level, to form a uniform bearing for the steel-trough decking. The bolt-holes at one end of each trough were slotted to allow for expansion of the decking.

The road or carriage-way was formed of metalling, broken to 2-in. and 1-in. gages in equal proportions, mixed with boiling coal-tar. The troughs were completely filled with tarred metal, and were covered to a depth of 7 ins. at the crown and 5 ins. at the curbs, being well punned and afterwards rolled and covered with sand. Drainage from the surface of the roadway is provided for by 30 gullies having outlets through holes cut in the trough decking. The curbs are of Moreton Bay ash, 12 ins. by 9 ins., bolted to the steel decking; and the hand-railing is of hardwood posts and iron chains easily removable.

The approaches were made in cutting through the sandy formation of the banks, the cutting for the south approach having a maximum depth of 17 ft. The slopes were faced with bricks laid in cement; and concrete water tables were constructed at the foot of the slopes.

During the construction of this bridge exceptionally bad weather was experienced; and two of the highest floods known in the locality occurred, resulting in considerable delays, loss of plant and materials, and damage to the approaches. In April, 1894, two and a half years after the bridge was opened for traffic, the Herbert river was visited by the most disastrous flood that has ever been recorded in the district, considerable damage occurring to the tarred metal or asphalt roadway on the bridge, necessitating its entire renewal. In repairing the roadway the quantity of tarred metalling, which, on account of its depth in the troughs of the decking, required a long time to set sufficiently hard for traffic, was reduced by filling the troughs to a depth of 12 ins., and forming a surface over the decking, with Portland-cement concrete, upon which tarred metalling or asphalt was laid to a depth of 6 ins., and reduced by rolling to 5 ins. The concrete was composed of one part of Portland cement, one part of river sand, and six parts of stones from the river of 2-in., 1-in. and ¼-in. gages in equal quantities. The asphalt was formed of broken river-metal of 2-in. and 1-in. gages in equal quantities, mixed with ¼-in. screened river-gravel, in the ratio of six parts of stone to one of screened gravel. After being thoroughly dried, heated, and well mixed with the required quantity of boiling coal-tar, it was stacked to allow the superfluous tar to drain off, and then laid on the surface of the concrete and rammed and rolled. The surface was finished with 1 in. of tarred sand and screenings, composed of four parts of coarse sand and two parts of fine gravel screened, dried, heated and mixed with boiling coal-tar as before. After finishing, the entire surface was covered with clean sharp river-sand to a depth of ½ in.; and, to give sufficient time for the asphalt to harden, a month was allowed to elapse before the bridge was reopened for traffic.

The contract for the construction of this bridge was let in January, 1890, and it was completed and opened for traffic on the 4th of November, 1891, the total cost of the bridge and approaches amounting to £7,787 16s. 7d. The cost of the bridge, exclusive of approaches, amounted to £5,704 4s. 0d., or £11 17s. 0d. (nearly $60) per lin. ft. The cost of the concrete and asphalt work, together with some other necessary repairs, amounted to £684; the total cost of the bridge being thus increased to £13 3s. 6d. per lin. ft. ($66).

Balonne River Bridge, St. George.

This bridge is wholly of bloodwood (Eucalyptus corymbosa), and consists of twelve spans of 35 ft. each, with two end-spans of 28 ft. each; the total length over the decking being 481 ft., and the width of roadway between the curbs, 18 ft. The height of the bridge above the lowest or dry weather level of the river is 15 ft., the highest flood having reached a level of 16 ft.

Each pier has four piles spaced at 6-ft. 2-in. centers at the level of the headstock; the two outer piles having a batter of 1 in 8, and the two intermediate piles being planted vertically. The diameter of the piles, exclusive of sapwood, is 17 ins., the butt-end being placed downwards in every case. Each of the outer or battered piles was lewised to the rock-bed of the river, each hole being cut to a depth of 5 ft., the dimensions at the bottom being 46 ins. long by 14 ins. wide. The sides and one end were cut vertically, and the opposite end tapered so as to reduce the length of the hole at the surface to 26 ins. The sides and ends of each hole were carefully rough-tooled to exact lines; and properly-shaped wedges of seasoned bloodwood were then inserted, and made to bear evenly against the rock. The feet of the piles were squared for a length of 6 ft. 6 ins.; they were then inserted in position between the wedges, and firmly driven home, the whole being securely bolted together above the surface of the rock. The wedges and the feet of the piles before being fixed were twice coated with Stockholm tar; and, after fixing, the interstices were completely

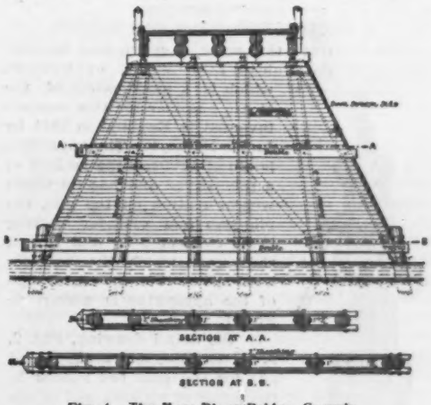


Fig. 4.—The Mary River Bridge, Gympie.

filled in with strong-cement grout. The two intermediate piles in each pier, and also the abutment piles, were planted in rock, the holes for which, 24 ins. in diameter, were jumped or excavated to a depth of 4 ft. The feet of the piles were freed from sapwood, and twice coated with Stockholm tar; they were then planted in the rock, the space round each pile being completely filled with cement concrete. The sites of eight of the twelve piers were above the summer level of the river, but the first four piers from the St. George side of the river were in water, necessitating the provision of a cofferdam for each pier, to admit of the holes in the rock being cut without the aid of divers. Each pier was capped with a 12-in. by

12-in. headstock inclined 4 ins. in its length towards the upstream side of the bridge, and provided with double 10-in. by 6-in. wailings above water or rock-level, three 10-in. by 12-in. struts between the piles, and double 10-in. by 6-in. diagonal braces. The walling and braces were cogged on to the piles, and the whole well bolted together. The upstream ends of each pair of wailings were shaped and blocked solid to form a cut-water, and were well secured with wrought iron straps and bolts.

Each span consists of five girders or stringers scarf-jointed over the piers, and carried upon single corbels, 14 ft. long, through which the girders were bolted. The corbels were cogged on to the pier headstocks; and, in addition to being bolted, the girders were keyed to the corbels with well-seasoned wedge-keys tightly driven, working 3 ins. square, and having a 4-in. projection on each side for tightening. The superstructure is secured to the piers by through-bolts and anchor-bolts. The decking consists of 9-in. by 4-in. planks laid transversely over the girders in one length from side to side, and spiked down with 8-in. by ½-in. spikes. The outer girders and corbels exposed to view are of hewn timber 14 ins. by 12 ins.; the inner girders and corbels being of round timber 17 ins. in diameter, exclusive of sapwood, adzed flat to a thickness of 14 ins. over all bearings and for the planks of the decking. The entire superstructure is built with an inclination of 4 ins. toward the upstream side to prevent lodgment of driftwood under the bridge decking in time of flood. The abutments were sheathed at the back of the piles with 4-in. planking, carried also along the wings of the abutments. The curbs measure 9 ins. by 6 ins., and are rounded on one edge and bolted through the decking and girders; the curb on the upstream or lower side of the bridge being raised 1½ in. to allow for drainage from the surface of the decking. The handrails, 6 ins. square, are placed diagonally on 9-in. by 6-in. intermediate posts, and 9-in. by 9-in. main posts over the piers, terminating at the ends of the bridge in 12-in. by 12-in. guard-posts securely fixed to the girders of the end spans and tenoned into the abutment headstocks. The handrailing is only 3 ft. above the decking, and of exceptional strength, without intermediate rails and wires, so as to offer as little resistance as possible during floods, and to enable it to withstand the pressure due to the accumulation of flood debris. Strong permanent handrails are to be preferred to movable handrails, which are troublesome and expensive, and their removal at the vital moment is often neglected.

The whole of the timber-work received three coats of oxide paint, with the exception of the decking, which was covered with three coats of Stockholm tar. Since it was opened for traffic, this bridge has been several times submerged by floods without sustaining injury.

The construction of the bridge was commenced in October, 1890, and it was opened for traffic in June, 1892, after many troublesome delays in consequence of wet weather and floods. The total cost amounted to £4,467 16s. 4d., inclusive of approaches, which alone cost £419 10s. 0d., the cost of the bridge per lin. ft. amounting to £8 8s. 4d.

The author also describes two bridges across the Mary River. We reproduce the cuts illustrating them, as they show sufficiently the features of principal interest in their construction.

A DIRECT-ACTING STEAM PILE HAMMER.

We illustrate this week a steam pile hammer made by the Vulcan Iron Works, of Chicago, which is a modification of the steam hammer for this purpose invented in England in 1841 by James Nasmyth. The apparatus is slung between the leaders of a pile driver and has its whole weight resting on the pile, the pile cap and cylinder casting being connected by four turned rods, upon which the hammer head slides. The general design of the apparatus is shown in Fig. 1.

Fig. 1.—View of Vulcan-Nasmyth Steam Pile Hammer.

In the detail drawing, Fig. 2, A is the hammer head, bored out for the four rod guides B, the lower or striking end of the head being of smaller diameter and passing through the cap D, which rests on the pile. The guide rods attach the cylinder C to the cap D, and are secured by keys at each end. The hammer head is attached to the rod of the piston E. The oscillating valve F works within a cylindrical chamber formed in the steam chest, this chamber being provided with three ports; port G opens into the lower end of the cylinder, H is the steam and I the exhaust port, steam being admitted from a flexible pipe attached at J. The spindle of valve F carries at one end (outside the steam chest), the arms or tappets K, L, which engage with lugs on the rod M attached to and moving in connection with the hammer head. These lugs are not in the same vertical plane, only one lug engaging with each of the tappets. At the end of the upstroke of the cylinder and hammer head the lower lug will have passed the tappet L without striking it, but will strike the tappet K, moving the valve so as to open communication between ports G and I, and allow steam to exhaust from below the piston. At the end of the downstroke the upper lug will pass the tappet K and strike the tappet L, moving the valve to the left, so as to open communication between ports G and H for steam admission under the piston.

In sinking test piles for the foundations of the Chicago Public Library (Engineering News, July 6, 1893), a Vulcan-Nasmyth hammer was used, weighing 4,500 lbs., having a stroke of 42 ins., and striking 54 blows per minute. The last 20 ft. were driven with a follower of oak, requiring 48 to 64 blows for the last foot, and as the ratio of blows without follower to blows with follower is as 1 to 2, it was estimated that only 24 to 32 blows would have been required if the last foot had been driven with the hammer striking the pile direct. In the same soil it required about 16 blows of a 3,000-lb. drop hammer falling 30 ft. to drive a pile the last foot, using a follower, and 32 to 36 blows of the same drop hammer falling 15 ft., also using a follower.

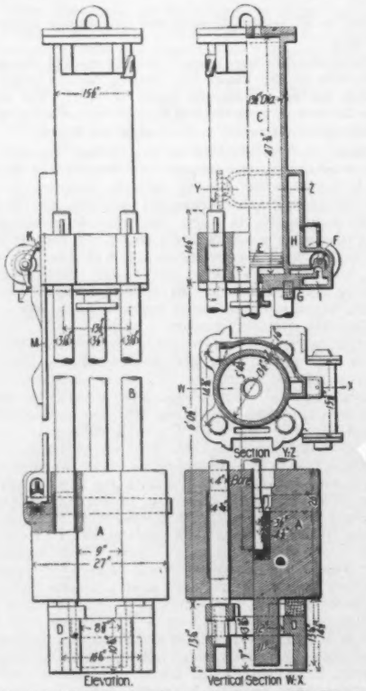


Fig. 2.—Details of Vulcan Nasmyth Steam Pile Hammer; Vulcan Iron Works, Makers.

UNIFORM METHODS OF TESTING IRON AND STEEL.

Several years ago a committee was appointed by the American Society of Civil Engineers to report upon uniform methods of testing the material used in metallic structures. The committee has made, we believe, one or two preliminary reports, and its final report has just been presented at the annual convention in San Francisco. An abstract, summarizing the recommendations of the committee was prepared by Mr. Henry B. Seaman, 40 Wall St., New York city, a member of the committee, who has had it printed for convenient reference, and will mail copies to those desiring them. We reprint this summary in full as follows:

Cast Iron.

We recommend the transverse tests of a specimen 2 x 1 ins. in section and 27 ins. long, resting flatwise on dull knife-edge supports 24 ins. apart, c. to c., with an applied weight of 2,000 lbs. or more, midway between them. The specimen, if of satisfactory strength when cast under the same circumstances as those which attend the casting of the full-sized piece, must carry at least the minimum weight named above, and exhibit when broken the fracture of gray iron of good quality. Failure shall be produced in not less than two minutes nor more than five minutes from application of the first load, and the bar must show a center deflection before breaking of at least 3-16 in., and must indicate a good quality of gray iron.

Wrought Iron.

The committee recommends that the expression "elastic limit" be confined in its use to its original meaning, since its more general adoption leads to ambiguity and to useless discussion and dissension. The usual methods of testing indicate the first strength or "yield point" of the material, and in order to avoid the objections already mentioned, the committee has confined itself to the expression "yield point" when applied to practical testing. The "drop of beam" is considered sufficiently accurate to determine the "yield point," but the increased accuracy of autographic records, or use of instruments of precision is recommended.

Experimental investigations show that the relative dimensions of a test piece become of little practical consequence if the gaged length exceeds about four times the greatest diameter of the specimen. It is therefore recommended that a minimum gaged length of 8 ins. be used for the general practice of testing specimens, with a distance of not less than 12 ins. between shoulders of the specimen, or between the jaws of the testing machine. Under these conditions, however, it is understood that the gaged length shall in no case be less than four times the greatest diameter of the test piece, and that the minimum thickness shall be ¼ in.; also that the sectional area of test piece shall not be less than ⅛ sq. in. In obtaining the final elongation, the curves of reduction each side of the point of fracture should be included in the measured length.

In testing it is recommended that the load be applied continuously and at a rate as nearly as practicable of 4,000 to 5,000 lbs. per sq. in. per minute below the yield point, and of 7,000 to 8,000 lbs above the yield point.

It is recommended that the ordinary bending test be continued, and that it be made rapidly with pressure, rather than with blows of a hammer, as the results are thereby more comparable. The nicked bending or fracture test, however, does not show any essential property of the material which would not be disclosed by the tests already mentioned, and hence its adoption is not recommended.

For the requirements of wrought iron with the tests outlined, the following are recommended:

	Bars, per sq. in.	Tension; plate, angle and other shapes.	Compression; plate angle and other shapes.	Web plates.
Yield point, lbs. (1=1,000)	26	26	26	26
Ultimate, lbs. (1=1,000)	50	48	48	46
Elongation in 8 ins., %.	20	15	12	8
Reduction of area, %.	30	20	16	12

Specimens should bend cold 90° without fracture, with inner radius of bending not exceeding twice the thickness of the test piece for bar iron, nor three times that thickness for plate and shape iron.

Rivet iron must be soft and tough, and pieces of the full diameter of the rivet must be capable of bending cold until their sides are in close contact without showing signs of fracture.

Rolled Steel.

The methods of testing wrought iron may, in general, be applied to rolled steel. In addition to these, however, the quenching test may be used to advantage, by which a specimen heated to cherry red is to be quenched in water of 82° F., and then tested as usual.

The drifting test is not recommended as a requirement for quality, and the annealing test is recommended only for full-size eye-bars.

For the requirements of rolled steel, it is recommended that a mean ultimate resistance be specified for each grade of steel, and that the ultimate resistance of the test specimen should not vary more than 4,000 lbs. per sq. in. either way from the resistance specified. It is also recommended that the yield point, the elongation and the reduction of area each be a function of the ultimate strength found in the test specimen.

The following requirements are recommended for the various grades of steel:

Ultimate Strength per Square Inch.

Low steel..... 60,000 lbs. ± 4,000
Medium steel..... 65,000 " ± 4,000
High steel..... 70,000 " ± 4,000
Yield point = 55% of the ultimate resistance of specimen.

$$\text{Per cent elongation in 8 ins.} = \frac{1{,}500{,}000}{\text{Ultimate}}$$

$$\text{Per cent reduction of area} = \frac{2{,}800{,}000}{\text{Ultimate}}$$

Rivet steel when heated to a low cherry red and quenched in water at 82° F. must bend to close contact

without sign of fracture. Specimens of low steel when treated and tested in the same manner must stand bending 180° to a curve, whose inner radius is equal to the thickness of the specimen without sign of fracture. Specimens of medium steel, as cut from bars or plates and without quenching, must stand bending 180° to an inner radius of 1½ times the thickness of the specimen without sign of fracture; while those of high steel, also without quenching, must stand bending 180° to a radius of twice the thickness of the specimen without sign of fracture.

Steel Castings.

In steel castings the tension test is recommended, with the following requirements:

Ultimate ..... 65,000 lbs. per sq. in.
Yield point..... 35,000 " " "
Elongation in 8 ins. = 15%.
Contraction = 25%.

Respectfully submitted, James G. Dagron, Robert W. Hunt, Henry B. Seaman, William H. Burr.

TESTS OF THE EFFICIENCY OF AN INJECTOR

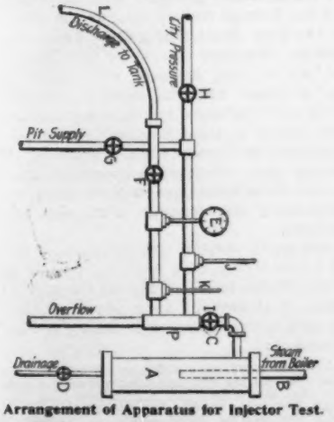
By Karl Andrén.

The following results were obtained from a series of experiments upon an injector manufactured by the Penberthy Injector Co., of Detroit, Mich. and listed as No. CC in their catalogue for 1895.

Four series of tests were made under the following conditions:

I. Greatest discharge, under constant steam pressure and suction head, against varying pressures in the discharge pipe, the water being supplied to the injector at the city pressure, 50 lbs.
II. Least discharge, under the same conditions.
III. Greatest discharge, under constant steam pressure and with a lift of the supply water of 9 ft. 10 ins., against varying pressures in the discharge pipe.
IV. Least discharge, under conditions of the third series. The accompanying sketch explains the arrangement of piping used in the tests.

A represents a separator, made of 4-in. steam pipe, and having cast-iron caps at the top and bottom, as shown. B is the steam pipe from the boiler: This passes centrally through the top cap of the separator and extends downward about half way between the two caps. This pipe is open at its lower end. The steam leaves the separator near the top cap and is carried to the injector P. E is a pressure gage in the discharge pipe and F is a throttling valve, by means of which varying discharge pressures may be obtained and registered on E. G is a globe valve in the lifting pipe, connected to the pit supply. This valve was closed, except in the lifting tests. H is a globe valve in the city water pipe. This valve was wide open during all tests on greatest discharge when city pressure was used. In all the tests the injector steam valve I was wide open, as recommended by the manufacturers. Preparatory to all tests on least discharge with city pressure, the limiting action of the injector was determined by alternate manipulations of the valves H and F, until the desired discharge pressure was noted at that point, directly after which the injector would fail to work without leaking at the overflow. In all lifting tests the globe valve H was closed. During tests for greatest discharge with suction the valve G was opened wide, the desired discharge pressure being regulated by means of the throttling valve F. In the lifting tests for least discharge, the valve G was operated in connection with the throttling valve F in a similar manner to that before described in the least discharge at city pressure. J and K are two accurate centigrade thermometers, set into oil cups in the suction and discharge pipes respectively. To the end of the discharge pipe is coupled a piece of rubber hose L. This leads to a wooden tank set on Fairbanks' scales, not shown in the drawing. The scale arm weight was adjusted to balance the tank when



Arrangement of Apparatus for Injector Test.

empty, and 350 lbs. in weights were placed on the scale pan. A boiler steam gage was also near at hand so that all readings were easily obtained from a stand near the injector. The time in seconds was noted for each discharge of 350 lbs.

The diameter of the injector combining tube was determined by the micrometer measurement of a soft wooden taper rod, which was accurately fitted to the smallest section of the tube. It was found to be 0.215 in.

Explanation of the symbols used in the equations:

W = Weight in lbs. of water discharged during the test.
S = Weight in lbs. of steam used during the test.
L = Total heat of the steam.
t_2 = Temperature in degrees Fahrenheit of the suction water.
t_1 = Temperature in degrees Fahrenheit of the discharge water.
q_2 = Heat of the liquid corresponding to the temperature t_2.
q_1 = Heat of the liquid corresponding to the temperature t_1.
350 = Weight in lbs. of the water + steam (condensed) discharged = capacity of the weighing tank during each test = W + S.

All the results were obtained by substitution in the following formula, which is adapted from the equation (219) in Prof. Peabody's "Thermodynamics of the Steam Engine."

$$W(q_1-q_2)+(W+S)\frac{AV^2}{2g}=S(L-q_1)$$

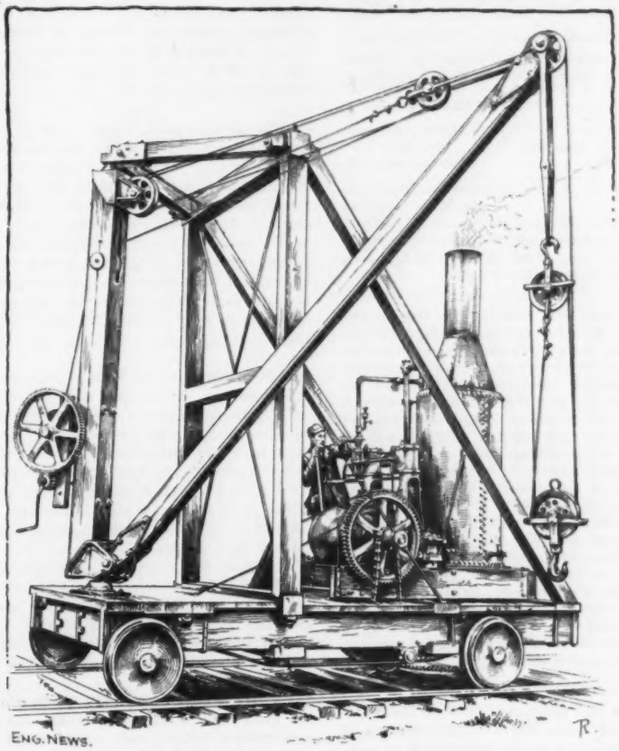
But since S = 350 − W

$$W(q_1-q_2+L-q_1)=350(L-q_1)-350\frac{AV^2}{2g}$$

and hence

$$W=\frac{350\left(L-q_1-\frac{AV^2}{2g}\right)}{L-q_2}=\frac{350\,(L-q_1)}{L-q_2}\text{(practically).}$$

The following deductions can be made from the accompanying tabular results of tests:



AN ECONOMICAL TRAVELING DERRICK CAR.

Tests of the Efficiency of a Penberthy Injector.

I. Tests with maximum discharge. Water supplied to injector under pressure of 50 lbs per sq. in.

Average Discharge head lbs. per sq. in.	Steam pressure (gage) lbs.	Temperature (Deg. F.) of Suction.	Disch'g.	Discharge gals., per hour.	Lbs. of water pumped per 1 lb. steam.
20	68	50	104	626	20.49
30	71	50	105.8	626	19.32
40	68	50	104	626	20.49
50	70.5	50	107.6	626	19.17
60	70.5	50	107.6	626	19.17
70	68.5	50	105.8	626	19.71
80	72	50	110.3	597	18.27
90	72	50	122	502	15.13
100	Injector leaked at overflow.				

II. Tests with minimum discharge. Water supplied to injector at pressure of 50 lbs. per sq. in.

20	71.75	51.8	202.1	242	6.68
30	70	51.8	199.4	243	6.81
40	71	53.6	199.4	242	6.90
50	71	53.6	199.4	245	6.90
60	71.75	53.6	192.2	256	7.32
70	70	53.6	179.6	271	8.15
80	70.5	53.6	163.4	315	9.50
90	70	53.6	158	336	10.04
100	Injector leaked at overflow.				

III. Tests with maximum discharge. Injector working with suction lift of 9 ft. 10 ins.

20	75	72.5	149	474	13.85
30	72	64.4	137.3	486	14.70
40	71.5	61.7	134.6	491	14.74
50	70.5	60.8	132.8	491	14.94
60	71	67.1	140.9	485	14.49
70	71	67.1	140.9	488	14.49
80	70	68	145.4	459	13.62
90	Injector leaked at overflow.				

IV. Tests with minimum discharge. Injector working with suction lift of 9 ft. 10 ins.

20	70.5	68.9	190.4	281	8.56
30	70	63.5	185	281	8.56
40	71	62.6	185	281	8.33
50	70.5	60.8	181.4	281	8.89
60	71	59	179.6	296	8.51
70	71	59	170.6	306	9.28
80	71	65.3	165.2	344.6	10.43
90	Injector leaked at overflow.				

1. Since the life of a boiler is greatly increased when fed with hot water, a larger injector than that size, which, when working at its maximum capacity, is just sufficient to feed the boiler, should be used. The considerable increase in the temperatures of the feed water, when the injector is working at least discharge, warrants this suggestion.
2. In case the injector is to be used as a pump, in which case it would generally be regulated so as to give the greatest discharge, it is seen that it is much more efficient against high heads than againtst the lower heads.
3. A comparison of II. and IV. shows that the discharge with a lift of 9 ft. 10 in. is greater than the corresponding discharge when the city pressure was used, while the final temperatures of each set vary only slightly. This is not true for the maximum discharges of each set.
4. In general, the maximum discharge of each class is decreased as the pressure head is increased, while the corresponding temperature of the discharge is proportionally greater. But a comparison of the minimum discharges of each class shows that the temperature of each discharge decreases as the pressure head is increased, while the discharge per hour is materially increased.

A TRAVELING DERRICK CAR.

The accompanying cut represents a simple and economical derrick, mounted on a car fitted with propelling gear, and intended for use in quarries and similar places, and in the construction of buildings, foundations, sewers, etc., where fixed derricks have many disadvantages. The car, derrick-post, boom and supporting frame are of timber, and on the car are a two-cylinder hoisting engine and a vertical boiler. A sprocket chain from the main shaft drives a countershaft under the car platform, while another chain, running from a smaller wheel on the countershaft drives a sprocket wheel keyed to the rear axle. The derrick has the ordinary cast-iron shoes and fittings, wire rope falls, and wrought-iron blocks and large sheaves. The car is 16 ft. long, with wheels set to 8 ft. gage of track, and it will work on a grade of 2%, with maximum load. The mast is 12 ft. high, and the boom 18 ft. long, the latter swinging through an arc of 270°. The weight is about 15,000 lbs. This machine is manufactured by the John F. Byers Machine Co., of Ravenna, O., It should meet the wants of a large number of manufacturers and others who could use a traveling crane to advantage in loading and unloading goods, machinery, etc., but cannot afford the expenditure necessary for an all-metal machine.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes to standing advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The advantages and disadvantages of the head house or "dead end" plan for the arrangement of railway stations are now under discussion in connection with the proposed new union station for Omaha, Neb. The present principal station is on the outskirts of the town, and a new one was proposed on practically the same site, but though work was commenced it does not seem probable that it will be carried to completion, as there is a strong movement in favor of a new and more central location, and accommodating other railways besides those using the present main station. This would be a terminal station, with a head house at the end of the train shed. Through trains would either have to head in, and then put out in a reversed position, a fresh engine being attached to what was the rear of the train; or else such trains must run past the station and then back in, pulling out again without being reversed. The daily papers appear to be decidedly in favor of a station on the new site, and the great terminal stations at Philadelphia and St. Louis are pointed to as examples of "head-house" stations used by through trains. It should be noted, however, that many through trains of the Pennsylvania R. R. do not now enter the Broad St. terminal station at Philadelphia, but pass by that city by a cut-off built for this purpose. On those through trains that do enter there is more or less inconvenience caused by the reversal of position and the necessity of reversing all the seats of the cars. A similar arrangement also used to exist on the Baltimore & Ohio R. R. at Baltimore, and the delays and inconveniences due to this arrangement were among the reasons for building the Belt Line tunnel, giving trains a through station. The question is largely one of traffic conditions. If there are many through trains, it may be advisable to so locate and arrange the station as to provide through tracks, but if the traffic is mainly terminal the head-house plan may be the best. The great terminal stations of the Pennsylvania R. R. and the Philadelphia & Reading R. R. in Philadelphia, appear to be open to objection in this respect, but the Grand Central station, in New York, being purely a terminal station, there is no need for considering any provision for through traffic. As to running past the station and then backing in, so as to avoid reversal, such a plan is very likely to be found inconvenient in many ways, especially as the traffic increases. In fact, we know of one good sized city in England where this arrangement became so troublesome that the entire terminal plan was changed recently, involving great expense, in order to facilitate the train movements. In view of the amount of through traffic at such a place as Omaha, it seems to be eminently desirable to provide through tracks, and not tie up the whole system by a head-house plan, and there should be little difficulty in doing this.

We occasionally receive letters in which the writers complain that we devote too little space to this or that or the other special department of engineering, in which they are especially interested; and say that they care nothing about any engineering literature aside from that which bears upon the work in which they are engaged. In conversation, too, with young engineers, and sometimes with older ones, we hear them too frequently say—sometimes even with a sort of pride—that they read nothing in engineering literature except what bears directly on their chosen specialty.

This mistake, as we believe it to be, is so serious in its results to the one who makes it, that we have thought it worth while to call attention to it here for the special benefit of any of our readers who may be cherishing some such erroneous ideas respecting the way to succeed in professional life. It is true, that specialization is a necessity at the present day; a man must take up some one subject in the field of engineering and completely master it if he would succeed; but if he allows this subject to absorb his attention to the neglect of all other departments of his profession, he cannot aspire to the highest positions, and it is often the case that a man with the broader talents, gained by a wider study of his profession, will outstrip him in preferment even in his chosen specialty.

The fact is that everybody instinctively distrusts the judgment of the man with one idea, or the man with a hobby; and judgment, it is to be remembered, is the greatest quality a professional man can possess. The young engineer, who, when he picks up an engineering journal or buys a book, reads only that which bears directly upon the particular line of work in which he is engaged, is deliberately narrowing his judgment and unfitting himself for the largest sphere of usefulness.

From another point of view, too, this policy of turning all one's energy in a single channel is a mistaken one. No man knows, and least of all the engineer, what he may be doing a year—five years—ten years hence. Changes come rapidly in the profession. A score of years ago many engineers were devoting themselves to railway construction as if their lives were to be spent in that work; but when the practical cessation of railway construction came, a half-dozen years ago, every one of them grasped eagerly at any knowledge or abilities he possessed that could be put to use in other fields of engineering. Alexander Lyman Holley wrote when a young man: "If there is anything certain in this world, it is, that I will never do anything permanently for a living but just this one thing, namely, build locomotives." And not only was he never engaged in a locomotive works more than a few short months after that time, but he won his fame in the field of metallurgical engineering.

The engineer of the present day is fortunate in having available a great storehouse of information in the technical journals and proceedings of technical societies, of which the engineer of early days knew nothing, and which were comparatively unimportant no more than a score of years ago. The engineer nowadays who gets in a rut or remains in ignorance of what advancement is being made in other departments of his profession, does so from choice and not from necessity; and cannot with justice complain if other men, more wide-awake, enthusiastic and up-to-date, outstrip him in the race.

The terrible railway wreck at Logan, Ia., with 31 deaths resulting, which is recorded this week, is the most serious disaster due to the system of operating trains by dispatchers that has been recorded in a long time. According to the best information available, the accident was due to the engineer of the excursion train which was wrecked leaving a station either without orders or in disobedience to orders to await the passage of a fast freight. It is of no use to lay the blame upon the engineer. No one supposes that his disobedience was wilful; no one can say what freak of forgetfulness caused him to make his fatal error. The emphatic lesson of all accidents of this class is that, in order to make men obey orders when the consequence of a failure to obey may be so disastrous, something more than written instructions are needed. Experience teaches that men are far less likely to disobey the instruction of a monitor which is constantly visible before their eyes like a semaphore or a train staff than they are the written message on a train order blank.

The Logan accident and the other serious accident at Altenheim, Ill., make a total of 36 deaths for the week due to excursion trains. In both these accidents it is altogether probable that the fact that the train was an extra was directly responsible for the disaster. The switching engine crew which left the switch open that caused the wreck at Altenheim would probably not have made such a blunder had the train been a regular one which they were accustomed to expect. The engineer of the train wrecked at Logan would have been far less likely to have blundered had he been accustomed to meeting the fast freight every day. Excursion trains are doubtless a necessity; but managers and superintendents should realize the extra hazard that attends their running and put in operation every possible safeguard to protect them.

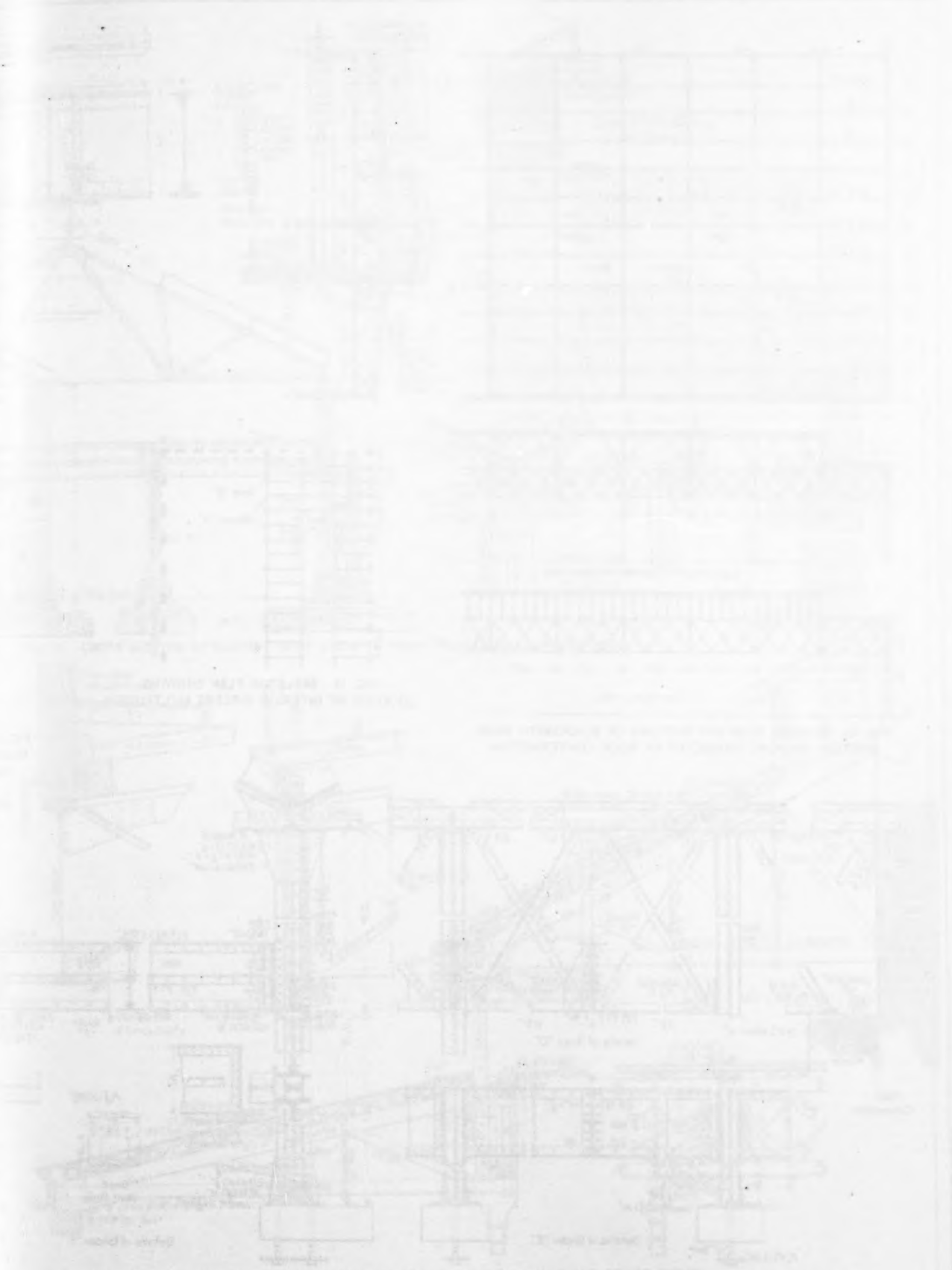
THE NEEDS AND POSSIBILITIES OF HARBOR IMPROVEMENT AT CHICAGO.

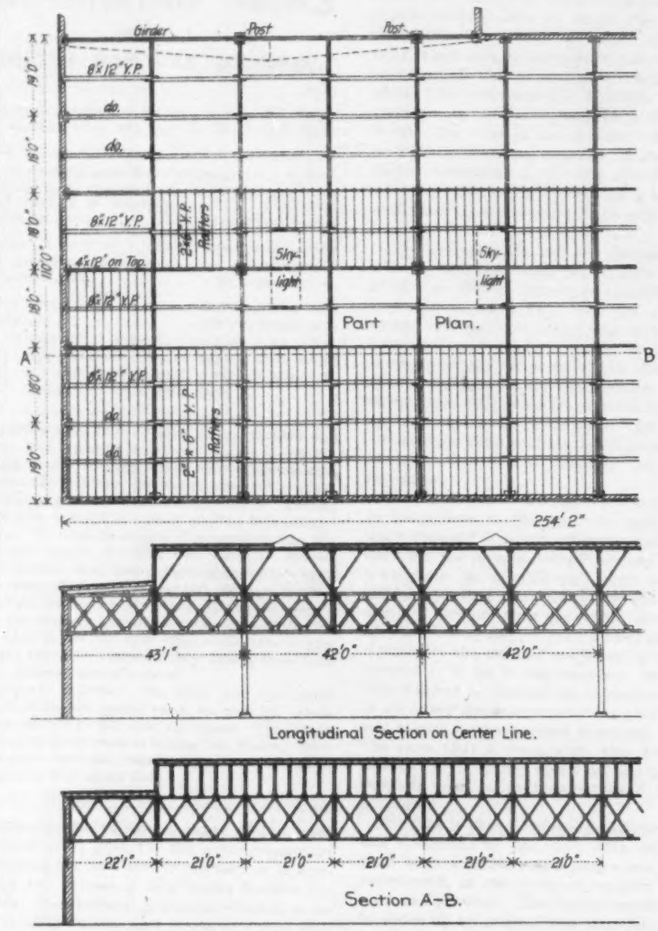
The decadence of the Chicago harbor, or more accurately the growing inadequacy of the Chicago River, to supply harbor facilities to the vessels entering and leaving that port, has from time to time received quite general discussion from the shipping interests of the Great Lakes, and especially from the vessel owners and merchants of Chicago itself. For some years the fact has been gradually forcing itself upon Chicago lake shippers that the city has outgrown its present harbor facilities, and the knowledge has occasioned brief comment in the daily papers and a few discussions of more thoughtful character. Little attempt at general concerted action to improve things has resulted, however, and this inactivity has proved a serious set-back to the Chicago River interests since it has enabled an adjacent harbor to gain considerable prestige, and the apparent favor of the Federal Government as the best, and in fact the only practicable, deep water harbor for Chicago. Whether the injury is to be a permanent one or not, depends very much upon whether a broad and far-sighted solution is sought of the problems involved and upon the energetic action of those having the greatest interest at stake in Chicago's lake commerce. Great engineering and commercial questions are involved, and some space may well be devoted here to a preliminary consideration of the more important of these.

Most engineers outside of Chicago, and probably not a few within that city, are largely ignorant of the straits to which the old Chicago River has come. A prominent daily paper of Chicago recently said in connection with a long discussion of this subject:

> Chicago's supremacy as a shipping center is seriously threatened. In fact the shipping interests do not hesitate to declare that the scepter has passed from the Chicago River; and that were it not for the adjacent Calumet River, the city marine trade would be doomed. The Chicago River, as it exists to-day, is a relic of a glorious and prosperous past. It can accommodate only the second and third class fleets, and is unknown to the modern magnificent lake steamships.

Despite its somewhat turgid rhetoric, this statement is deserving of credence; for if one turns to the reports of the U. S. Government engineer in charge of Chicago harbor for the past few years, substantially the same assertions are found. Indeed, in his latest report, that officer strongly advocates the development by the government of the Calumet River harbor, largely





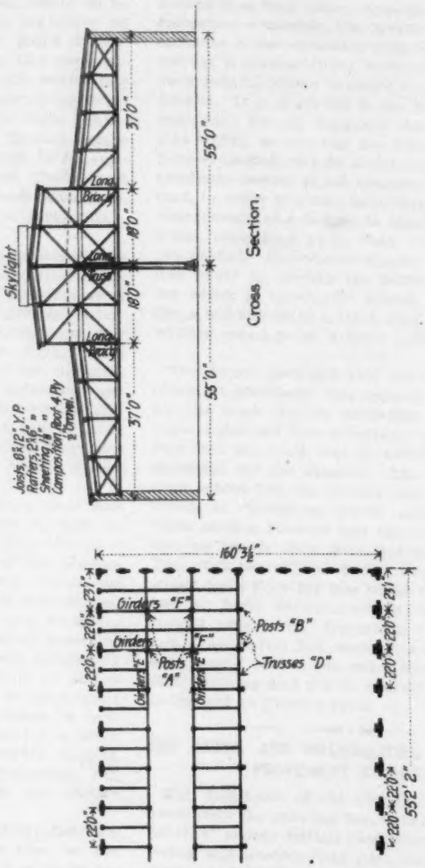


FIG. 13. SKELETON PLAN SHOWING LOCATION OF INTERIOR GIRDERS AND TRUSSES.

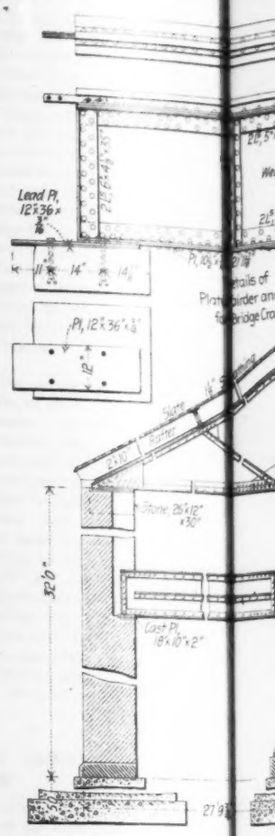


FIG. 16. GENERAL PLAN AND SECTIONS OF BLACKSMITH SHOP ADDITION SHOWING CHARACTER OF ROOF CONSTRUCTION.

FIG. 17. DETAIL SHOW MANNER OF CONNECT MAIN BUILDING AN ADDITION FOR BLACKSMITH SHOP

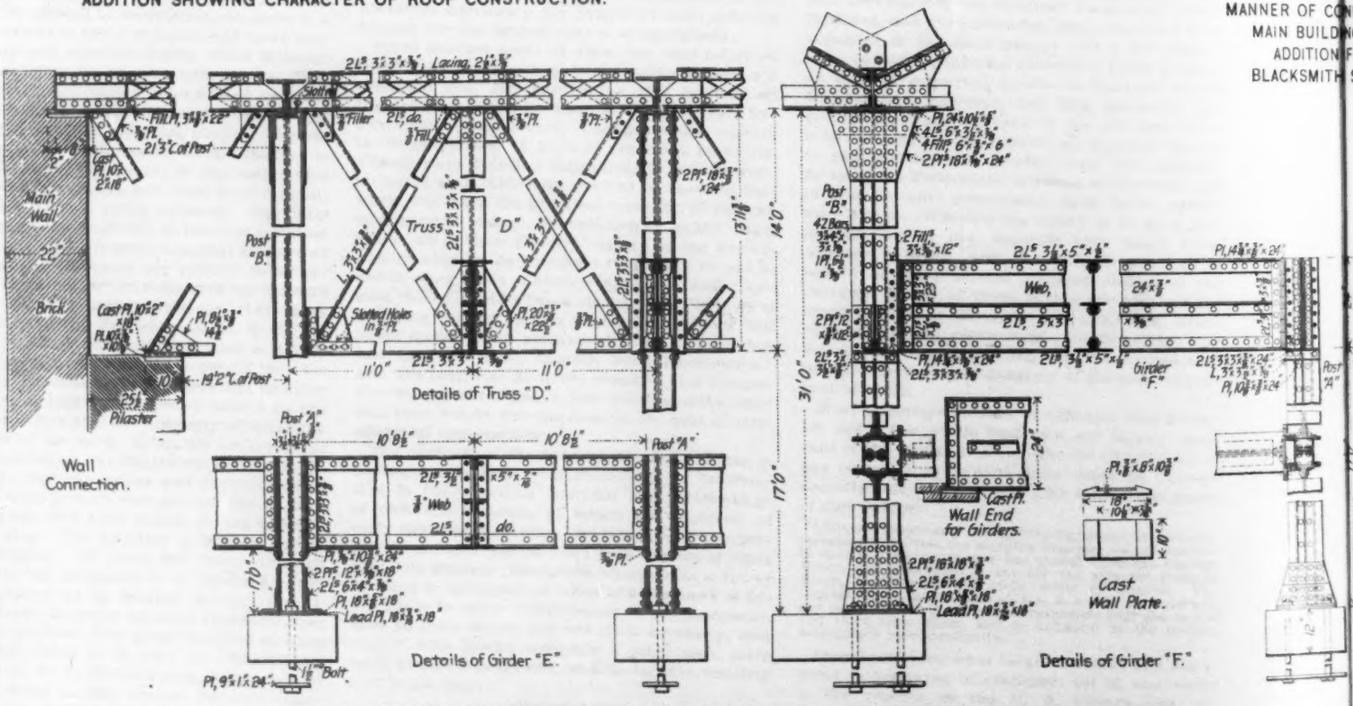


FIG. 14. DETAILS OF INTERIOR GIRDERS AND TRUSSES TO CARRY SHAFTING, CRANES, HOISTS, ETC.

GENERAL SHOPS ILLINOIS CENTRAL R. R. B

John F. Wallace, M. Am. Soc. C. E., Chief Engineer Illinois Central R. R. H. W. Parkhurst

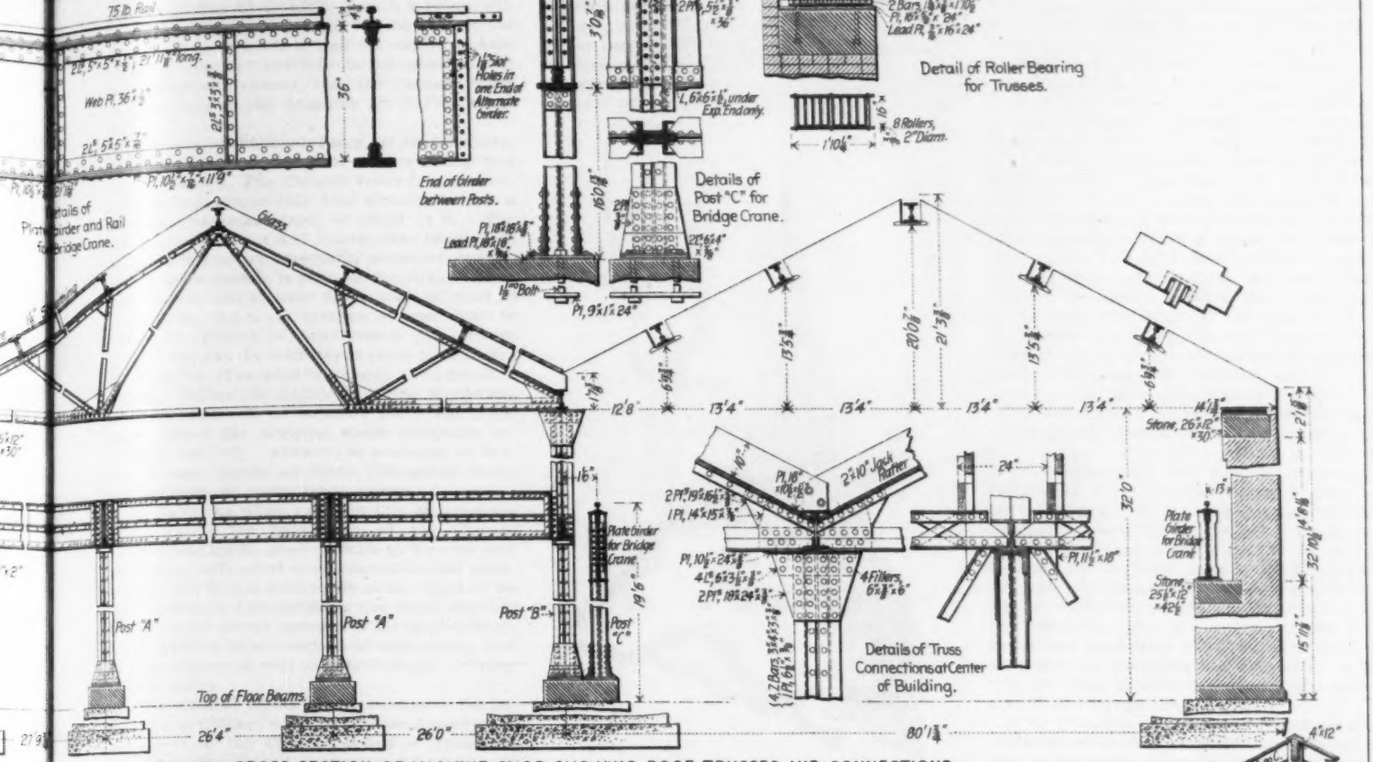


FIG. 12. CROSS SECTION OF MACHINE SHOP SHOWING ROOF TRUSSES AND CONNECTIONS.

DETAIL SHOWING OF CONNECTING BUILDING AND DITION FOR KSMITH SHOP.

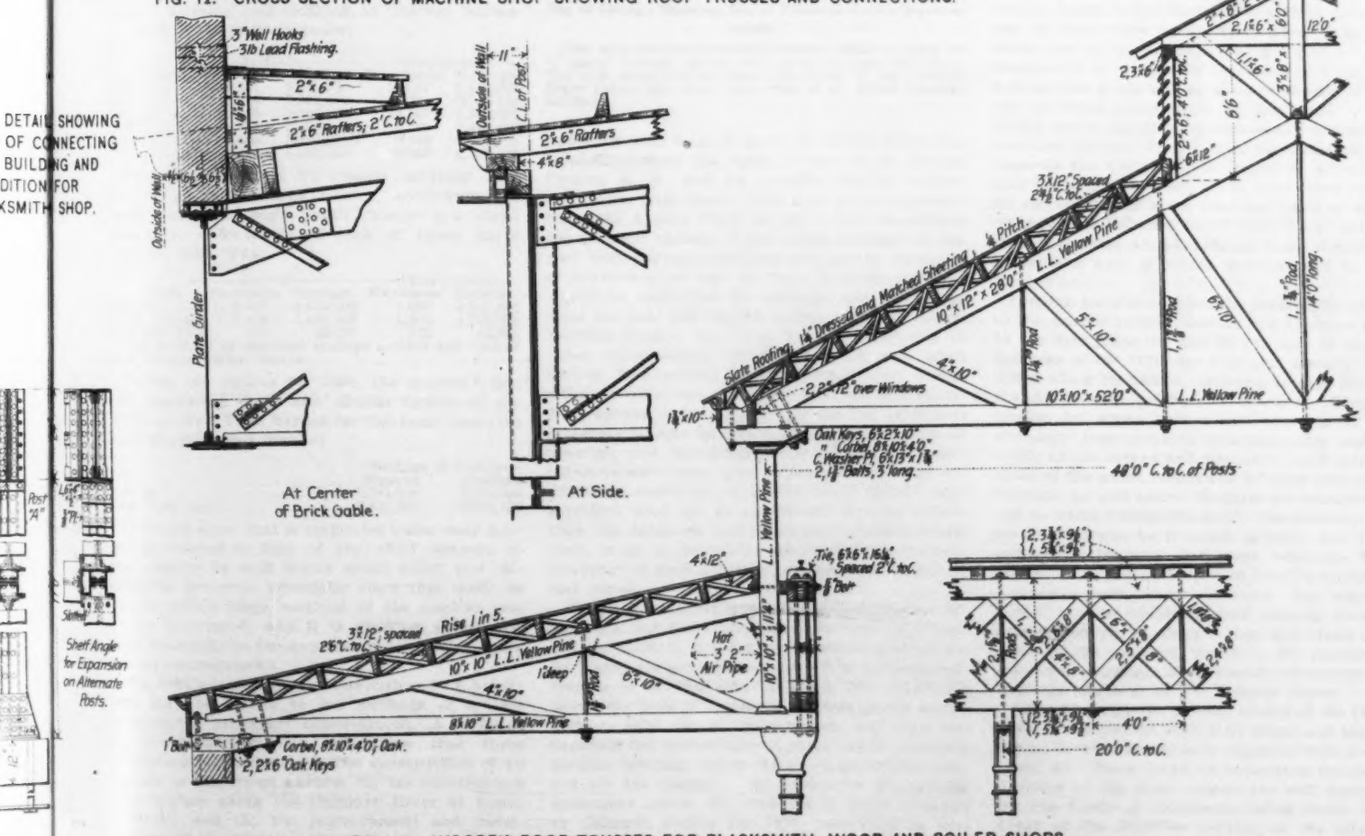
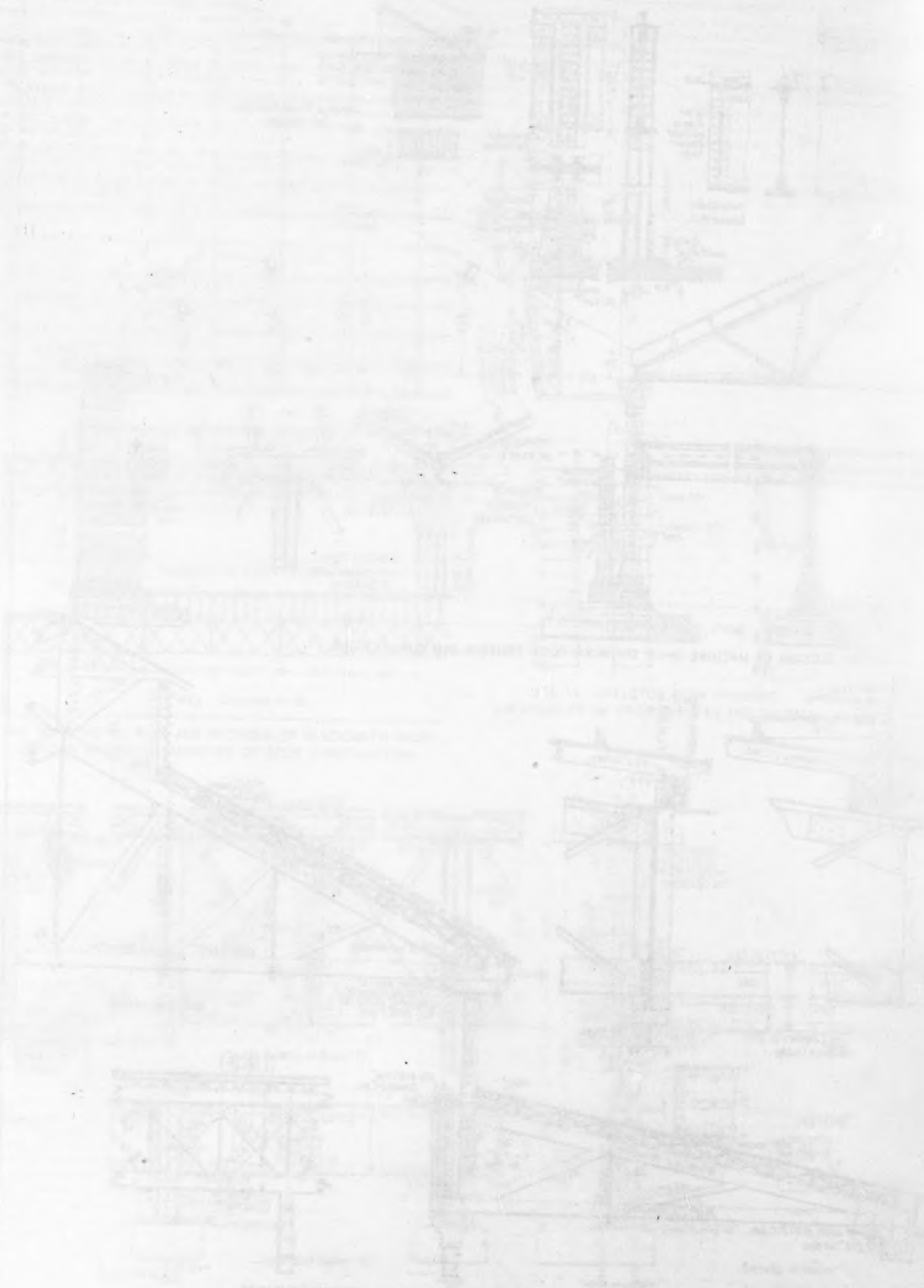


FIG. 15. WOODEN ROOF TRUSSES FOR BLACKSMITH, WOOD AND BOILER SHOPS.

R. R. BURNSIDE, ILL., LOCOMOTIVE SHOPS.

Parkhurst, M. Am. Soc. C. E., Chief Engineer of Bridges and Buildings, Illinois Central R. R.

CHAS. HART & SONS, LITH., 25 VESEY ST., N. Y.



upon the argument that the Chicago River is incapable of accommodating modern lake vessels and affords only limited opportunities for improvement. The advisability of such a policy will be considered further on; but for the present the single fact to be noted is that the expert opinion of the government engineer tallies with that of the newspapers, namely, that the Chicago River is inadequate to the demands for harbor facilities.

The reason of this inadequacy, as hinted above, is the growth in the size of vessels conducting lake commerce. The Chicago River is a narrow, crooked and unutterably foul stream, having a maximum navigable depth of about 14 ft. For the lumber schooner and fourth-class barge such accommodations are reasonably sufficient; but the day of these vessels is past on the Great Lakes. The modern lake steamer has a draft of from 16 ft. to 20 ft., and a net tonnage of from 2,000 to 3,500 tons. Indeed, in many vessels this tonnage is exceeded, and the tendency is every year toward larger rather than smaller vessels. The result is obvious. Either the harbor facilities of Chicago must be improved, or adjacent ports will gradually attract the shipping which naturally belongs to that city. Already, as a matter of fact, the Calumet harbor at South Chicago is drawing the business of the large vessels.

The questions which arise on this showing are these: (1) Is the importance of the Chicago River's lake traffic great enough to warrant any great and costly effort to accommodate and maintain it? (2) If it is sufficiently great, what is the best method of accomplishing the result desired? Evidently the second question is the more difficult, for it involves considerations of engineering, cost and expediency as well as considerations of commercial policy.

Let us consider briefly the question as to the importance of Chicago's lake commerce. According to the report of the Chicago Board of Trade for 1895, the following is the number and tonnage of vessels arriving and clearing at Chicago harbor for each of the past six years:

	Arrivals.		Clearances.	
Calndr. year.	No. vessels.	Tonnage.	No. vessels.	Tonnage.
1890	10,507	5,138,253	10,547	5,150,665
1891	10,224	5,524,852	10,294	5,506,700
1892	10,556	2,966,626	10,567	5,968,337
1893	8,754	5,456,037	8,789	5,449,470
1894	8,250	5,181,260	8,329	5,211,160
1895	9,212	6,329,702	9,363	6,392,497

These figures cover all vessels arriving and clearing at the "Chicago District," comprising the three ports of Chicago, South Chicago and Michigan City. The traffic of each of these three ports in 1895 was:

	Arrivals.		Clearances.	
Port.	No. vessels.	Tonnage.	No. vessels.	Tonnage.
Chicago	7,637	4,602,508	7,687	4,585,834
South Chicago..	1,404	1,682,003	1,504	1,760,838
Michigan City..	171	45,191	172	45,825

That is 72.2% of the total tonnage entered and cleared from Chicago harbor proper.

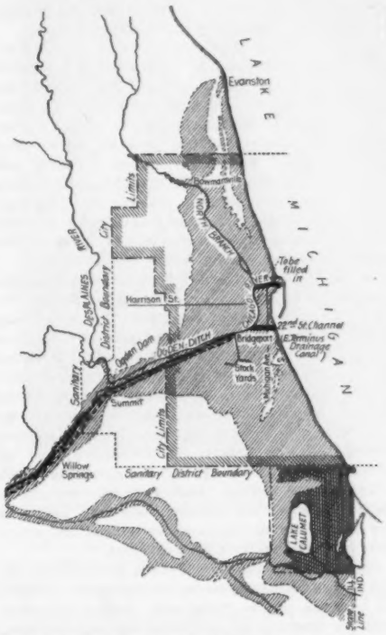
Taking the figures for 1894, the poorest year, and comparing them with similar figures of the traffic of New York harbor for the same year, we have the following results:

	Tonnage of vessels.	
	Entered.	Cleared.
Chicago	5,181,260	5,211,160
New York city	7,819,230	7,514,162

It would seem that a traffic by water only second in volume to that of the chief seaport of the country is well worth great effort and expense to preserve, especially since this traffic is one in which large sections of the country are deeply interested, and it is growing in amount each year despite the notoriously insufficient harbor accommodations.

The first question being thus disposed of, attention may be turned to the methods of accomplishing the necessary improvement. A study of the accompanying map will show that three methods are possible. (1) The construction of an outside or lake front harbor; (2) the construction of a harbor along the Calumet River at South Chicago; and (3) the improvement and development of the Chicago River in connection with the Drainage Canal. The lake front harbor has been placed first, not because of its importance, but because it is the least available solution and the soonest dismissed.

The practicability of a lake front harbor is doubtful for several reasons: (1) The length of lake front available is too small. It has been estimated by a competent authority that the space available for piers inside the present breakwater will give about 7½ miles of dock line or less than 20 per cent of the dock line at present used. If the breakwater were extended from Lincoln Park to Jackson Park, there would be about seven miles of shore line available if unobstructed. But the



Map of Chicago Showing Site of Proposed Harbor Improvements.

(The area shaded represents surface below a plane 20 ft. above Chicago datum--low water in Lake Michigan. The area cross-hatched about the mouth of the Calumet River shows the area more than 5 ft. below Chicago datum.)

approach to at least 75 per cent. of this shore line is obstructed by the right of way of the Illinois Central R. R., and its possible riparian rights, and by the Lake Front Park, now under construction. (2) A lake front harbor would necessitate the transfer thereto of the entire business of the port with railway terminals and all the incidents of commerce, or else the cost of doing business would be multiplied by drayage and lighterage from the coal and lumber yards, grain elevators, packing houses, etc., now located from one to three miles inland. Briefly, then, a lake front harbor, if available in every other way, would either revolutionize the whole business and industrial arrangement of the city by its wholesale transfers or else involve a tremendous system of drayage and lighterage with all the increased expenses attendant upon such a system. The engineering questions of a lake front harbor construction need not be considered, for the reason that the business and industrial considerations seem to us to determine effectually the impracticability of such a harbor, except as a matter of last resort.

Before considering in detail the comparative advantages and disadvantages of the two other harbor possibilities, a few general considerations are advisable. On general principles it is certainly advisable to develop the facilities for commerce where the bulk of commerce already exists rather than to take the opposite course, and thus necessitate the destruction of great vested interests already existing, unless there is a paramount reason for the change. As shown by the tabular statement above, the business of South Chicago or Calumet harbor for 1895, estimated in tonnage of vessels entered and cleared, is about one-fourth that of Chicago harbor proper. On the single basis of best accommodating the greatest bulk of existing commerce, then, the improvement of the Chicago River would seem to be demanded rather than the improvement of the Calumet. Are there sufficient superior advantages at Calumet to counterbalance the disadvantages of changing commerce?

To enable a clear understanding of the possibilities of the Calumet River as a harbor, the accompanying map has been so drawn as to show by shading the area south of the mouth of that stream of which the major portion is below the level of 5 ft. above Chicago datum (low water in Lake Michigan). Altogether there are about 30 square miles of this area, of which there are normally under water about 14 miles (0.5 square miles) of river from 7 ft. to 10 ft. deep, with low, sedge-lined banks, and about six square miles comprised in Lakes Calumet, Hyde and Wolf, with a maximum depth of about 3 ft. below Chicago datum and with flat, marshy shores. At times of high water in Lake Michigan about 20 miles of this area are below lake level. Now it is this land that must be the site of a city, for transferring the harbor and commerce to the Calumet means the transfer of the industrial population supplying that commerce, and it behooves us to consider its adaptability to this end.

It is evident that the topography of the land necessitates the raising of a large portion of its area adjacent to the water courses in order to fit it for building, and also that the dredging of a large area to provide the necessary deep water for vessels is necessary. The cost and difficulty of building on such "made ground" overlying a bed of muck and sand are well known. As the level is such that the water courses will be motionless unless flow is induced artificially, it is evident also that the difficulties of drainage, sewerage and general sanitation are very great. In short, commerce and population will bring here their thousand and one problems and difficulties, as great and probably greater than have attended the growth of Chicago itself.

If we put aside these broad commercial considerations and confine ourselves purely to the question of providing a certain area of channel of a certain depth, width and freedom from curves, it can be done more easily at Calumet than anywhere else, perhaps, in the Chicago District. The topography is reasonably favorable to great freedom in such work, and so also are the small number of vested interests to be disturbed. Many things which incommode such constructions in a populous district do not exist here, and in these respects the Calumet has superior advantages over the Chicago River. It is upon these favorable circumstances alone that the claim or superiority for the Calumet River harbor site is based. Doubtless there are advantages to be utilized, but in another way, of which mention will be made further on.

Leaving the Calumet for the present, let us turn to the harbor possibilities on the Chicago River. In the first place we find 75 per cent of the lake business of the "Chicago District" already established along its banks. Quoting from a report of the government engineer in charge: "Along this stream are great lumber and coal yards, grain elevators, meat packing establishments and generally all the means and appliances and paraphernalia of the great commerce by lake centering at Chicago, as well as the facilities for transfer from rail to water transportation." The commerce and all its adjuncts, be it noted, is here; and it only remains to improve the river adequate to its needs. It is not necessary to build a harbor and commerce both, as at Calumet, for commerce surely implies buildings and railway terminals and population, in short a city, and these do not exist in the Calumet marshes. To improve the waterway adequate to the needs of commerce, is then the problem on the Chicago River.

Approximately the present length of the Chicago River and adjacent slips is 21 miles, and the number of lineal miles actually supplied with docks is about 40. These docks, on account of the peculiar Y-shape of the river course, are well distributed for the needs of commerce, being right in the heart of the business portion of the city. The river, however, is crooked and narrow, is crossed by numerous bridges, and its depth over the street tunnels under it is only from 15 ft. to 19 ft. To fit it for the demands of commerce it must be widened, straightened and especially increased in depth. With buildings and docks and railway ter-

minals close to and along the whole length of its banks and with tunnels underneath its bed, such improvement is a large and difficult problem, but difficult more on account of the financial problems than on account of the purely engineering problems. In its most serious phases it is purely a business proposition, and if the proper interests conjoin, it can easily be solved as a business proposition.

Before urging this point further it is desirable to turn to another feature of the Chicago harbor question. Already the city has partly completed in the great Drainage Canal, what is practically an extension of the Chicago River, a distance of 28 miles westward. This channel has a depth of water of 25 ft. and a minimum width of 160 ft. (about one-half its length, and that on the portion adjacent to Chicago is 202 ft. wide). The law authorizing the channel demands that the volume of flow shall be at least 300,000 cu. ft. per minute, and an additional 20,000 cu. ft. per minute for every 100,000 increase in population over 1,500,000. The channel as built will pass 600,000 cu. ft. of water per minute. To provide the minimum flow, the Chicago River may be enlarged at an estimated cost of about $750,000, and to provide the maximum flow it must be doubled in size or else an independent supply channel must be constructed. This supply of water is a practical necessity which confronts the city of Chicago unless the Drainage Canal, costing some $30,000,000, is to be useless. This necessity at once suggests that the construction of an adequate harbor for Chicago should go hand in hand with it. The same enlargement of the Chicago River or construction of a supply channel that completes the Drainage Canal constructs a harbor for Chicago, or at least can be made to do so without the slightest injury to the canal as a sanitary work, and at no inordinate increase of expenditure.

It may be argued, of course, that the supply of water for the Drainage Canal can be furnished through the Calumet River by extending that stream west to connect with the canal about midway of its length. So, indeed, it can, but with no advantage to Chicago or to the canal, but only an advantage to the Calumet River and the few large property-owners who control the land along its banks. The population tributary to the Chicago River, which has paid the great bulk of the cost of the canal, can hardly be expected to forego the possible commercial benefits of their expenditure for the sole benefit of the population which has paid but a very small part of this cost, and this is to what the development of the Calumet River as a feeder amounts. Above all this, however, is the policy of the Sanitary District of Chicago, which controls the location of the water supply to the Drainage Canal, and this policy as far as it is defined is to take the supply from Lake Michigan through the city of Chicago.

Assuming that the harbor improvement and drainage work is to be done conjointly, the engineers of the Drainage Canal maintain, we believe, that only two alternatives are presented, either (1) all the water for the Drainage Canal must be taken through the Chicago River, or (2) all must be taken through an independent supply channel. The reason for this is because if both routes are used (the river and the new channel each supplying part of the water) the floods coming down the North Branch of the river instead of passing down the South Branch to the canal will in part at least go east into the lake through the main river. Now, to make the river capable of supplying all the water required by the Drainage Canal its cross section will have to be about doubled, which, with all the property interests along its banks means a tremendous expense. On the other hand, if a supply channel be excavated from the lake to the South Branch, the main river mouth must be closed. The preferable plan can be determined only by the determination and detailed comparison of the financial and engineering conditions governing the two routes, and these data are not yet available in detail, although they have been determined for the most part by the engineers of the Drainage Canal.

In a general way the engineers of the Drainage Canal announce that a channel 250 ft. wide and 22 ft. deep from the lake along 22d St. to the South Branch, and thence to the Drainage Canal, will cost about $10,000,000 with all bridges and approaches complete. By filling the river from its mouth to the fork, a strip of land 200 ft. wide and one mile long is regained right in the heart of the city. The value of this, about 26½ acres of land, has been estimated to be from $15,000,000 to $18,000,000, based on real estate values in the business section, which, it is claimed, will probably more than counterbalance the destruction of dock property necessitated by the filling. Of course the main bulk of the dock property, which is along the two branches of the river is not affected at all.

By the arrangement outlined, the city would secure a 22-ft. channel from the lake to Lockport, Ill., nearly 30 miles, both banks of which are available for docks and slips, and also the present river channel undisturbed north of 22d St. except for the closing of the present main outlet about one mile. This river, when dredged, will give a navigable depth of 15 ft. without disturbing tunnels or other structures crossing it. This supplies a harbor equal at least to anything possible at South Chicago, and right in the heart of the commercial development which demands it.

The only doubtful feature in the above plan appears to us to be the proposition to fill in the present main channel of the river. The advantage of eliminating all the bridges and tunnels which now separate the North Side from the main business district of the city, is, of course, an attractive one; but, on the other hand, the opposition to so radical a change is sure to be extremely powerful. As the river is a navigable waterway, Congressional sanction will doubtless be necessary for its abandonment as proposed; and the interests which will oppose the change, including the owners of property, docks, etc., along this two miles of water-front, can be relied on to oppose the proposition at every step of its progress.

It appears to us that the reason given above by the Drainage Canal engineers for filling the present main channel of the river are hardly weighty enough to warrant so enormous an undertaking. If there is danger that with two independent outlets to the Chicago River, one of them would discharge into the lake in times of flood, the proper course to pursue, it would seem, would be to build a lock in the new 22d St. channel, and let the gates be closed whenever floods would cause a flow in this channel toward the lake. As there are very few days in the year when this would occur, the lock gates would be open practically all the time, and would be no obstruction to navigation of any importance. Again, with two channels existing instead of one, obstructions due to a wreck in the channel, a drawbridge out of order or other temporary block to one of the channels would be of comparatively little importance. The current in the channels, also, would be of less velocity if both channels were open than if one had to carry the entire flow. It may be claimed that the engineers have designed the new 22d St. channel of such capacity as to carry the maximum flow of the canal without a velocity of current so great as to interfere with navigation; but if this is the case, would it not be better to save part of the cost of the 22d St. channel by reducing its dimensions?

The value of the land which would be acquired by filling the present Chicago River may be used as an argument for the work; but we should like to see more of the details on which this estimate is based. Would not the depreciation and property damage consequent upon the abandonment and filling up of this waterway amount to more than the value of the area thus acquired? Would not the carrying out of any such work, moreover, be made still more expensive by the delays which interested property-owners would doubtless bring about by prolonged litigation?

But the question whether the present main river should be abandoned or not is only a detail. The chief question under consideration is whether the Chicago or the Calumet shall be the seat of Chicago's shipping trade; and the outline above given seems to point clearly to the former as the common sense solution of the problem. The cost of the work will be great, of course, but that it will be so very much greater than the cost of an equally adequate harbor along the Calumet River is not so very evident. Even if it is greater, expense alone is not germane. The question is rather where the expenditure will make the largest returns in serving commerce. Even if we admit that superior facilities for harbor development exist at Calumet, the people will not ship commodities there unless it becomes the marketing point. If it does become the marketing point, the railways will go there and the population as well, and the burden of commerce will be shifted to a new point and divided. The problem is to be solved on the ground where it exists, just as the track elevation and drainage problems of Chicago have been solved. Amputation is sometimes necessary, but we do it only to save life and only after other resorts have failed. Rather, we try to cure and heal the injured member, knowing that in a partly crippled state even it is better than no member at all. And we never attempt to amputate the body to stick it onto someone else's sound limbs, and this is practically what trying to transfer Chicago's lake business from the at present crippled Chicago River to the youthful Calumet amounts to.

The Calumet River is doubtless one of the several natural advantages which Chicago possesses for developing a certain class of commerce, namely, commerce by water, and it should be improved for this reason. But the Chicago River is a similar and older and at present more important advantage for the same purpose. By accretion—the manner in which all commerce grows—it has developed a water traffic of great and growing dimensions, and now that improvement is necessary to increase and maintain this commerce, it should not be withheld. The opportunity for this improvement and the manner in which it may be brought about have already been suggested, but the facts necessary for a detailed discussion are not yet available, nor indeed are they necessary for the present purpose, which is to point out the broad salient factors entering into the problem of improving Chicago harbor.

To summarize briefly:

(1) The impediments to navigation at Chicago must be removed, i. e., the harbor facilities must be improved and extended, if commerce is not to be burdened in competition with other lake ports.

(2) A lake front harbor cannot be seriously contemplated as practicable with its present encumbrances, and the necessity of transferring business and facilities for business or establishing a vast system of drayage and lighterage.

(3) Facilities for commerce should be provided where commerce exists, for if commerce can be shifted at all, it cannot be shifted without also transferring population and facilities for business, i. e., destroying vested interests. Adjacent possible harbors as at Calumet are useful for developing subsidiary business centers and should be improved as such interests demand, but not to the neglect of the harbor already handling the bulk of the commerce nor with the idea of replacing the main harbor, unless the latter is incapable of improvement.

(4) Chicago harbor is capable of improvement by prosecuting work conjointly with the Drainage Canal work, and with comparatively little disturbance of vested interests.

LETTERS TO THE EDITOR.

Diagram of Frog and Switch Values.

Sir: Refering to your issue of July 2, p. 15, "Diagram of Frog and Switch Values," it might have been well to have added that the formula and diagram refer to track of 4 ft. 8½ ins. gage, and to a switch throw of 5 ins. By some this would be understood, but possibly not by all.

Yours very truly,
H. S. Jones.

Marion, Ohio, July 6, 1896.

Civil Service Examination for Construction Inspector.

Sir: On August 5, 1896, the New York City Civil Service Board will hold an examination for the position of Inspector of Construction, at 10 o'clock a. m. Candidates must have a knowledge of massive masonry in difficult foundations, pile work, sewer work, street work and pipe laying. Any citizen of the United States over 18 years of age is eligible. Applications may be obtained from the undersigned. The examination will be in writing, arithmetic, experience and technical knowledge.

Yours respectfully,
S. William Briscoe, Secy.

New Criminal Court Bldg., New York city, July 14, 1896.

English Sewer Flushing Practice.

Sir: Adverting to your issue of May 21, may we supplement for the interest of your readers, your article on English sewer flushing practice in that number, by giving you the point proved by the Douglas inquiry, viz., that of the syphons used by the 79 corporate bodies asked, 64% are of our own manufacture, as against 36% of all other makers combined. To us, as makers of the original deep trap syphon, such a proof of the superiority of our apparatus is very encouraging.

We are, yours faithfully,
Adams & Co.

York, England, June 23, 1896.

Car Storage Tracks in Railway Yards.

Sir: In referring to that part of Mr. Appleton's letter in your issue of July 9, commenting on the article, in the June 18 issue, on yards and terminals, which states that it is preferable for storage tracks for empty cars to have both ends open: In my own experience I have found that empty-car storage tracks are more likely to give trouble if open at both ends than if closed at one end. In the former case the cars are constantly being crowded toward the lead at the far end, where they often foul in trying to pass a common point. As to empty-car storage tracks being made the length of an ordinary switch engine draft—this would be all right if the cars were always handled in lots of that length.

Respectfully,
W. L. Derr.

Port Jervis, N. Y., July 13, 1896.

Stability of Steep Earthwork Slopes in the Tropics.

Sir: Noting what Mr. Silvanus Miller, M. Am. Soc. C. E., says in your issue of June 25, with regard to steep slopes standing better in some cases in the tropics than flatter slopes, and your comment on the same, I would add that it is not necessary to go nearer the tropics than South Carolina to find instances in which this is the case. On the South Carolina & Georgia R. R., near Aiken, S. C., there are cuts through a red clay in which it has been found that the banks having a slope of less than ½ to 1 stand much better than those nearer the more common slope of 1½ to 1.

The reason in this case seems to be that the surface becomes baked so hard by the sun that on the steep slopes the rain seldom breaks through this crust, while it is much more likely to do so on the flatter slopes.

Respectfully,
C. S. Phelps, Civil Engineer.

Charleston, S. C., June 29, 1896.

Very Low Prices for Reservoir Construction.

Sir: At a bidding this week in a town on the Ohio River, the present tendency toward low prices was well illustrated. Walls 17 ins. thick, of stone laid in cement with the face well plastered to insure a perfect joint, were offered for $2.00, and some stone are expected to be in the excavation. This work is to be done on a very steep hill with no roads leading to it and no water nearer than 1,000 ft. Sand is about the same distance away. The hill has an elevation of 200 ft. above the town. For concrete in the bottom 6 ins. thick with a top coat of Portland cement, $2.40 per cu. yd. was bid.

The settling reservoir, 15 ft. deep, will have 17-in. stone walls and a 17-in. partition wall through the center. It is partly in excavation and partly fill and was let at 12 cts. per cu. yd. and $2.50 per cu. yd. of masonry, the latter including plastering the face of the wall. The concrete bottom in this is to be 6 ins. deep with a Portland cement facing and was let at $2.75 per cu. yd.

Other prices were as follows: Pipe laying, including cost of lead, 10 cts. per ft. for pipe 6 to 8 ins. laid 3 ft. 6 ins. deep. Pipe, $18.65 cts. per ton for 22,500 lin. ft., of which 12,000 is 4-in. Specials, 2¼ cts. per lb. Hydrants, double-nozzle, 4-in. inlets, $15. Intake well for air-lift pump, 25 ft. deep, 7 ft. diameter, 13-in. brick walls, $300. Yours truly,

A Bidder Who Was Too High.

July 9, 1896.

An Incident of the St. Louis Tornado.

Sir: The enclosed photograph, which shows somewhat faintly a piece of wood driven through the web of a plate girder, is of interest as indicating the high velocity of the wind which prevailed during the St. Louis tornado.

The timber specimen itself, though quite inaccessible, was gathered in early by some enterprising relic hunter, before the writer had an opportunity to examine it closely. As seen from the track above, on the day after the storm, it appeared to be the end of a 2 × 6 in. pine plank that had been driven about 4 ins. through the girder web and then been broken off and somewhat shattered.

The girder shown is on the south side of the through girder span at the east end of the approach to the Eads bridge, in East St. Louis. It had been in use 20 years and is in good condition. The web plate is of 5-16-in. iron and 6 ft. deep.

The hole in the web of the girder is below the level of the track and 15 ins. above the bottom of the girder. An irregular shaped piece of metal, 9 ins. long and 1¼ to 2 ins. wide has been punched entirely out of the 5-16-in. web plate. The upper and right hand edges of the hole are nearly straight and in the plane of the web sheet.

Pine Plank Driven Through a Plate Girder on the East Approach to the Eads Bridge in the St. Louis Tornado.

At the bottom and at the left hand corner, the plate is bent inward, irregularly, the maximum distortion being 1¼ ins.

Yours truly,
Julius Baier.

Turner Building, St. Louis, Mo., June 27, 1896.

Comments on Track Standards.

Sir: It would have added much to the value of table "A" of "Standard Track of American Railways," published in your issue of June 25, if the weights per yard or the sectional area of the angle bars were given. We venture to say that a means of comparison between the sectional area of the joints and the weights of the rails, as used by the different roads mentioned in the table, would form a very interesting subject for study by railway engineers.

It would also have added interest, if, in connection with the bolts used, it was stated whether the figures given were the diameters of the bodies of the bolts, or the diameters of the tops of the threads, or, if the threads were spun on the bodies and raised above them or merely cut in the ordinary way.

It would be interesting to learn why one road—the Chesapeake & Ohio—used 9-16-in. spikes with a 100-lb. rail, and another—the Chicago, Rock Island & Pacific—used ⅝-in. spikes with a 60-lb. rail.

Very truly yours,
R. Hinchliffe & Co.

100 Washington St., Chicago, Ill., June 27, 1896.

(We believe that the weight of angle bars is generally proportioned to the weight of the rail. The bolt diameters we suppose to be in every case the diameter of the body, and spun or raised threads are used little if any on track-bolts. Our correspondent apparently thinks that the weight of spikes should be proportioned to the weight of the rail. We are not clear that this is the case. In a heavy rail with a great deal of lateral stiffness, the spike on adjacent ties help each other. The heavy rail, by reason of its broader base, is less likely to tip, and, as it indents the tie less, it has less up and down motion which tends to loosen the spikes.—Ed.)

Low Charges for Engineering Work.

Sir: Apropos of the efforts of your valuable journal to raise the profession to the high plane to which it is justly entitled and to educate the public up to a just appreciation of engineering services, we submit a clipping from the * * * which is illustrative of the reason why engineering is looked down upon, and why men of brains and experience are compelled to leave the profession or accept carpenters' wages.

(The clipping enclosed is as follows: Ed.)

The water-works committee reported a proposition from * * *, hydraulic engineer, to draw plans and specifications for the new system, including details or working plans with estimates of cost, etc., the work to be done by the engineer for $600. The proposition was accepted by the council by a unanimous vote. Work will commence at once on the plans and specifications, location of pipe line, etc. The completed plans will have everything in shape to advertise for the necessary material, labor, etc., to carry out the entire scheme, and it is expected the work will be well advanced before winter comes.

The work referred to means the procuring of a supply of water from * * *, a distance of about nine miles, and means final surveys and location of route, also surveys for intake, complete detail plans for probably two pumping stations, intake, steam and pumping plant, etc., reservoir, stand pipe, distribution system, estimates, specifications, etc.

This work will cost in the neighborhood of $225,000. (The city of * * * has power to issue bonds to the extent of $250,000). There will be no difficulty in estimating from this what would be a fair percentage for proper engineering service.

The gentlemen referred to in the clipping is City Engineer of * * * and possibly on this account can afford to do the work cheaper than the private engineer; but the fact remains that such men do more real injury to the profession in one year than all the technical journals can counteract in two; and the average town committeeman (not without reason) has come to the conclusion that he can purchase professional skill as he would potatoes and about as cheaply. Can you not give your readers the benefit of your opinion on this subject.

Correspondent.

June 17, 1896.

(We publish the above letter as received, merely substituting blanks for the names of persons and places. As evidence of the fact that the tendency to cheapen engineering service does not come entirely from the beginners in the profession and those who call themselves engineers on a very slim foundation of training and experience, we may remark that the engineer criticised is an Associate Member of the American Society of Civil Engineers. In reply to our correspondent's request for our opinion, we would say that according to our best judgment, in engineering as in other things, people are very apt to get about what they pay for. The city that thinks it is going to get $5,000 worth of engineering work for $600 will be pretty sure to find itself disappointed. No engineer, no matter what his ability or experience, can afford to give an enterprise the study, investigation and examination it should properly receive if his compensation is fixed at a sum barely a tenth of what the work is fairly worth.—Ed.)

An Experience with a Cheap Engineer.

Sir: There are a number of small towns throughout the country which aspire to possess water-works. They appoint commissioners who think a civil engineer ranks about, not quite, with a good mechanic, and if he wants over "twenty shillin" a day it is too much. So they begin to write letters to different engineers and see who will come cheapest and get up their plans and specifications. I am sorry to say there are some "cheap engineers" to be had; and the result is generally disastrous to an honest contractor who wishes to bid on the work and make a fair profit.

He tries to bid according to the specifications, but finds if he does so he will be too high; and if he bids low, according to the way he thinks the work will eventually be done, and he is not the chosen one of the "cheap engineer's" fancy, he will get most beautifully left if he is unfortunate enough to get the work. For an illustration, I would like to give a few extracts from a specification for works recently advertised to be let in your paper. I have a copy of the said specification and shall preserve it as a curiosity. I would send it to you to be printed, but I fear some other "cheap engineer" might see it and learn some new tricks.

I was employed by a contractor to help him make up his bid. We, with about a dozen other contractors, began to ask questions of the "engineer," as the specifications left so much to the imagination, and as for the plans—well, as one of the bidders remarked, "I never seen nothing like it in over 35 years' experience." I will simply remark that the plans, what there was of them, showed how the work was NOT to be built.

I quote from the specifications:

Plain cast-iron pipe shall be, hub and spigot, 12 ft. in length, exclusive of bell (which shall not be less than 3½ ins. in depth), smooth, sound and perfect, and be coated inside and out with coal pitch and oil varnish, and not vary more than 4 per cent from the weights herein specified.

That reads like an "old chestnut," as all pipe is supposed to be made that way, and generally is, regardless of engineers' specifications; but on searching carefully this interesting document we find that there are no weights specified.

On asking the "engineer," he answered: "The usual

weights." Then the bidders rally around the commissioners, and they, under pressure, issue a "supplement" (which I enclose), specifying that the weights shall be "as per Radford, Va., Pipe Co. Standard."

Next, specifications call for a "reservoir 125 ft. × 50, and 10 ft. deep, partly in excavation and partly in embankment (by the way, the commissioners said the reservoir was not to be built that way, as any fool would know if it was made that way the concrete lining would crack, so it was going to be made all excavation, no matter if the plans and the 'engineer' did say the contrary). The bottom shall be covered with concrete 8-ins. thick, and the sides with concrete 18-ins. thick, and shall be made water tight. The concrete shall be composed of Portland cement, sand and broken stone to be approved by the engineer and mixed and placed in the work as he directs."

The contractors asked the "engineer" in what proportions this concrete was to be mixed, and he replies, "the usual proportions." On being pressed for his version of "the usual proportions," he said "equal parts, one each of cement, sand and broken stone; you know you can't get concrete too rich."

Some of the contractors left without making a bid, knowing it was of no use, as events proved. The "particular" contractor bid $5.50 per yard for this "rich" concrete, probably knowing if he got the job he would not have to make it quite so rich. These are only a few of the "incidents" in these plans of what was not intended to be built, and specifications that did not specify. I only mention these two as a specimen and to show what engineers and contractors have to contend with.

Respectfully yours,
"Victim."

New York, July 1, 1896.

(We may add to our correspondent's very interesting letter that vexatious as the case is for the contractors who encounter such "cheap engineering," the case is vastly worse for the towns or cities for whom such work is done. The taxpayers there are the sufferers, and in the end will have to pay for every dollar saved in the engineer's fees, many dollars in increased cost of work or work badly designed and improperly carried out. Beware the counsel of a cheap adviser, is a proverb that is true of engineering advice as of any other.—Ed.)

Testing Work at the Massachusetts Institute of Technology.

Sir: I have been very much pleased from time to time to receive in the "Technology Quarterly" the results of tests made in the engineering laboratories of the Massachusetts Institute of Technology, which are referred to in your editorial of July 2.

Assuming them be made with care, I have found them to contain very valuable information for use in my office; in fact, additional knowledge for the profession which I have been unable to find elsewhere.

I must thank the Institute for turning its attention to these practical problems which we need to have solved, and giving us the results as early as practicable; though I agree with you that some of the results should be explained more fully.

Respectfully yours,
Hiram Mills.

66 Broadway, Lowell, Mass., July 8, 1896.

Sir: Your editorial notes in your issue of July 2, on the pamphlets entitled "Results of Tests in the Engineering Laboratory of the Massachusetts Institute of Technology," seems to call for a few words by way of reply. The objections made are, as I understand the editorial:

1. That there is no index.

2. That the tensile tests of steel and iron have not been classified, but are arranged in the order in which the tests were made.

3. And mainly, "the lack of any summary of results, or of any explanation whatever, as to what the tests are intended to show, and do show."

4. By way of emphasizing the above, you say, "Then why not say, boldly and plainly, just what information of practical value is contained in this labyrinth of tables? In the absence of some guide of this sort, we greatly fear that the busy practising engineer will never attempt a search through this bewildering mass of figures merely on the chance of digging out some valuable piece of knowledge."

It should be observed that these pamphlets are reprints from the "Technology Quarterly," and are published in order to furnish to engineers, as early as possible, the results of tests made in the engineering laboratories, particularly those made on full size pieces, and under practical conditions; so that they may have at hand, at as early a date as possible, the additional knowledge furnished by the individual tests, without waiting until such a complete series should be made as to warrant drawing extensive conclusions of a general nature. It, therefore, seemed unnecessary to provide each pamphlet with an index of its own, as the headings, with the classification of subjects now used, would, of themselves constitute some sort of an index. On the other hand, there certainly will be a classified index when a larger number of pamphlets have been issued. That a good classification is desirable is, of course, true, and efforts will always be made to improve the classification. The persons to whom the pamphlets are primarily intended to be useful, are, precisely, the "busy engineers," and they have not, as a rule, the time to map out the amount of knowledge on a certain subject, and to proceed to deduce theories or formulas; but their special interest is with the particular problem that they have in hand.

Thus, if the "busy engineer" proposes to use a certain timber column with a bolster, the results of a few tests on full size columns with bolsters, such as he will find in the summary given on page 231 of Vol. III., will give him information as to the real strength on which he can rely, such as he cannot obtain elsewhere, as far as I know.

Moreover, I have, a number of times, known "busy engineers" to consult these, or similar tests of full size pieces to decide upon what to do in some important work. I have also had a number of letters from prominent engineers, expressing the opinion that these results will be valuable for reference in their offices.

In giving the results of tests, accompanied by suitable summaries, but without attempting to theorize, or draw conclusions of a general nature, we are following the example of other engineering laboratories, such as that at Munich, that at Berlin, that at Zurich, and that at the Watertown Arsenal. I will add that the tests that have been made on full size pieces, furnish a good deal of opportunity, in connection with tests made at other laboratories, to do a good deal of theorizing, and to overthrow certain ideas that have been handed down by tradition; but such study and discussion is an entirely different thing from a simple record of observed facts, which these pamphlets are intended to be. Moreover, it will be observed that Vol. III. contains more details (accompanied by summaries) than Vols. I. and II., and that it is intended to follow the method pursued in Vol. III. As to the high and low values of moduli of elasticity of certain specimens of steel, quoted in the editorial, I will say that these are not the only high and low ones in the tables, and that such values will be found also in the reports of other laboratories, as that at Munich, and that at Watertown Arsenal; hence, if these results are in error (of which there is no evidence) the error is one prevalent among other laboratories. Moreover, the work of which the results are published in these pamphlets that is performed by students, is done under such close supervision, and so carefully checked by trained instructors that the results have the same degree of reliability as though the tests had been performed by the latter.

One typographical error should be corrected in Vol. I., page 139, line 24 of the table, viz., the modulus of elasticity printed 21,813,000 should be 27,813,000.

As to the case of the pulsometer, possibly it would have been better to have figured both kinds of duty; so as to include both the cases in which the pulsometer is ordinarily used, instead of giving only one.

Very respectfully,
Gaetano Lanza.

Engineering Laboratories, Massachusetts Institute of Technology, Boston, July 8, 1896.

(Perhaps we should have said in our editorial note referred to that the defects against which our criticisms were directed, are by no means peculiar to the publications of the Massachusetts Institute of Technology. On the contrary, they are exceedingly common in engineering literature. This publication of detailed logs of tests without explanation or comment is partly a relic of the times—not so long past—when records of engineering tests of every sort were a rarity and engineers carefully preserved in their notebooks all they found. What we contend is by no means that published tests should necessarily be accompanied by the pet theories or ideas of the one who makes the tests. Our position is merely that if knowledge is to be imparted, it is the duty of the one who gives it to spare no pains in smoothing the path of the learner. Print a mass of figures in a table without explanation, and one engineer may, after difficult toil, find the valuable truth which the figures conceal. Add a word as to what is to be sought in the same table, and ten will benefit by it who could not spare time to hunt it out unaided.—Ed.)

LEGAL DECISIONS OF INTEREST TO ENGINEERS.

Regulations of Water Company.

A water company cannot shut off water from a water taker for non-payment of an old, overdue, and disputed installment of water rates, after having accepted payment for a subsequent installment. The water taker may prevent such shutting off by an injunction in equity, and the court cannot, in such proceeding be required to investigate the merits of the unpaid and overdue and disputed installment. The water company must resort to a court at law if it would enforce such claim.—Wood v. City of Auburn (Supr. Ct., Maine), 32 Atl. Rep. 906.

Notice of Defective Streets.

It is not necessary in order to charge a city with negligence or carelessness for defective street crossings, that notice of the defect should be brought to it by actual complaint. If the city carelessly and negligently permits defects to exist in its street crossings, no matter how caused, for so long a time that notice is presumable, then it becomes liable if a person is injured thereby, without fault or negligence on the part of such person.—Junction City v. Blades (Ct. of App., Kan.), 41 Pac. Rep. 677.

Prior Establishment of Street Grades.

The acceptance of a city charter by a town does not impliedly work an adoption by such city of street grades established by the town, so that the city cannot change such grades, without complying with a statute, forbidding a city to change a grade of a street which has been legally established unless damages are first assessed and tendered to the abutting owner.—City of Huntington v. Griffith (Supr. Ct. Ind.), 41 N. E Rep. 589.

Measure of Damages for Land Taken for Sewer.

The fact that the proximity of a sewer has a detrimental effect on land, part of which was taken for the construction of the sewer, so far as the injury is due to proximity secured by the taking of such part, and would not have resulted but for such taking, should not in determining the owner's damages be excluded as harm merely anticipated from the future use of the sewer.—Lincoln v. Commonwealth (S. J. Ct., Mass.), 41 N. E. Rep. 489.

Reasonableness of Water Company Regulations.

A corporation which has a franchise for supplying water to a city, and the use of the streets, becomes affected with a public use and assumes a public duty, and has a right to establish reasonable rules regarding payment of rates and to decline to furnish water to any one who refuses to comply with such rules; but to make such rule valid it must, in itself, be lawful and just, and must not be discriminatory in its nature.—American Water-Works Co. v. State (Supr. Ct., Neb.), 64 N. W. Rep. 711.

Assessment for Sewer.

Under Act May 16, 1891, providing for the appointment of viewers to assess the cost of a sewer on the property benefited, the cost of a main sewer can be assessed only on abutting property, and not on that of non-abutters having no present sewer connections, but whose property may be drained by future branches to be made. Where an abutting owner was assessed under such act, with the cost of a 15-in. main sewer, where a 10-in. local sewer would have been sufficient, the excess in the cost between a 10-in. and 15-in. sewer must be borne by the municipality.—Park Ave. Sewer (Supr. Ct. of Pa.), 32 Atl. Rep. 574.

Finalty of Engineer's Estimates.

An action was brought upon a written contract to recover a balance claimed to be due for work done in constructing a section of the defendant's roadbed. By the provisions of the contract, payments were to be made, during the progress of the work, on monthly estimates furnished by the engineer, 15% being retained until the completion. Upon the completion of the work, and its acceptance by the engineer, he was to make a final estimate of its quantity, character and value, and the amount ascertained by him to be due was to be paid to the plaintiffs. The estimates thus made by the engineer were to be final and conclusive as to both parties, subject to the right of the president to revise and alter them. Whether the last estimate furnished was final and fixed the rights of the parties was the principal question at issue. It was contended that it was because it was furnished after the completion of the work and was not revised or altered by the president. In form it was not a final estimate, nor such an estimate as was contemplated by the agreement. It was similar in form to the preceding monthly estimates, and was made, as they had been, at the end of the month, to show the amount of work done since the last estimate. But, like the preceding estimate, it showed the total allowances and payments. By agreement of the parties, expressed or implied from their acts, the court says this estimate might have become a final one, but neither party could arbitrarily make it such. It was competent for the defendant to show that a final estimate had been made by the engineer, fixing the quantity, character, and value of the work, and the amount due therefor, and testimony tending to prove this should have been admitted. The defendant should have been allowed to prove, also, that the engineer, at the instance of the plaintiffs, in order to enable them to meet their payments, had increased the amounts of the monthly estimates beyond what was justly due, with the understanding that, in the final estimate, a reduction of the proper amount should be made. The fact that the engineer was in the employ of the defendant, the court further holds did not commit it to the consequences of his misconduct while acting as an arbiter for both parties, and an award which was the result of collusion with the plaintiff was not binding upon it. It was the right of the president, under the agreement, to revise and alter the estimates made. This right he did not exercise, and his approval or disapproval of an estimate submitted did not affect its character as a final award of the engineer.—Gonder v. Berlin Branch Ry. Co. (Supr. Ct. of Pa.), 33 Atl. Rep. 61.

Engineer's Lien on Work Performed.

A civil engineer who makes field notes, maps, charts, and drawings, while employed by a corporation in and about the construction of an irrigating canal, on books and papers furnished by the corporation, the court of appeals of Kansas holds, is entitled to a lien on such field notes, maps, charts, and drawings, and has a right to retain possession of the same until he is paid for making the same.—Amazon Irrigating Co. v. Briesen (41 Pac. Rep. 1116.

Rights in Use of Tracks.

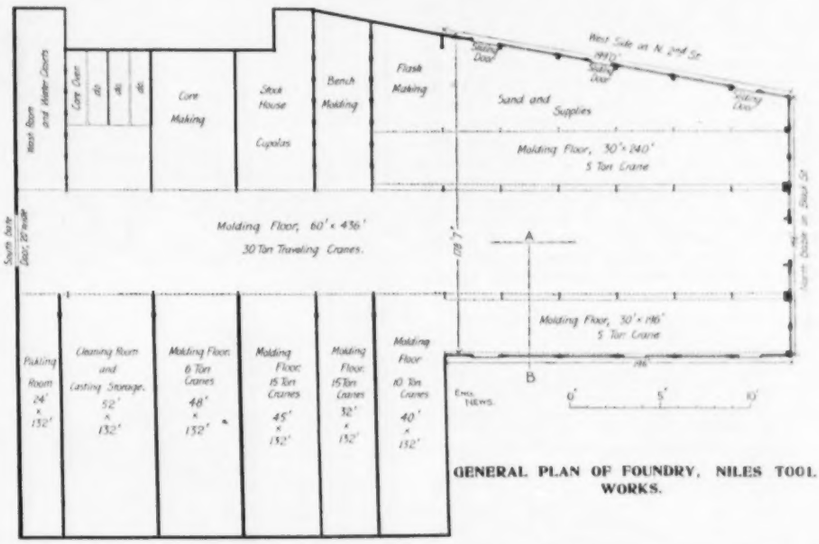
Railway companies with franchises to use the same street may be required to use one track, and in the exercise of this power a company may acquire the right to use the tracks laid by another, but compensation for such use must be made. If the tracks thus subjected to the common use of two companies are unfitted by age, long use or other cause, to serve the purposes of these companies, an action may be maintained by one against the other to compel the repair or reconstruction of the tracks at the joint expense of the companies.—New Orleans & C. R. Co. v. Canal & C. R. Co. (Supr. Ct. of La.) 17 So. Rep. 834.

NEW FOUNDRY OF THE NILES TOOL WORKS, HAMILTON, O.

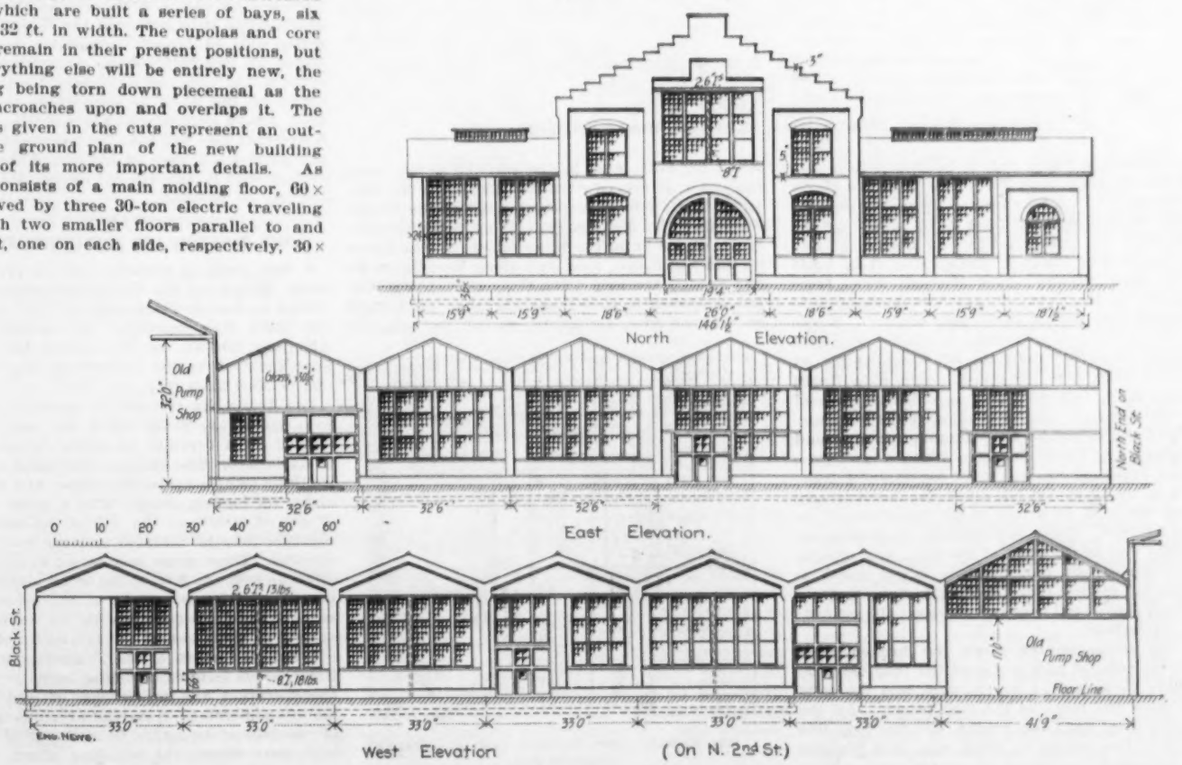
The Niles Tool Works moved from Cincinnati to Hamilton, O., in 1871, erecting at that time what was considered one of the most complete shop plants of the day. It consisted of a machine shop, 65×400 ft., one section 40 ft. wide being used for erecting heavy work, and being served by overhead traveling cranes, operated by hand, and a foundry building, 50×200 ft., placed at right angles to the machine shop. The minor buildings need not be mentioned. As the business of the company grew, additions were made from time to time. To the north of the original machine shop and parallel to it was first built an erecting shop, with an overhead traveling crane, and a wing for tools, the whole covering an area of 75×400 ft. A little later another erecting shop, 50×400 ft., also served by overhead traveling cranes, and a two-story building, 50×400 ft., were erected. The second floor of the two-story building was used for milling machines, gear cutters and small lathes.

From time to time, while the above work was going on, additions were made to the foundry to meet the new demands being made upon that department. These additions were made in the form of bays, varying in width from 30 ft. to 48 ft., and in length from 300 ft. to 400 ft., and extending at right angles from the main building. Altogether six of these bays were constructed, each with an overhead traveling crane. Finally, it became necessary to enlarge still further and reconstruct the foundry, and the plan was adopted of building over the original foundry and extending north, with a central building 60 ft wide by 437 ft. long, the span to be served by two 30-ton overhead electric traveling cranes, with four motors each. This construction retained the bays which had been added from time to time, extending east and west from the original foundry building, and the same idea was carried out on the extension of the center building, on each side of the increased length of which are built a series of bays, six in number, 32 ft. in width. The cupolas and core ovens will remain in their present positions, but almost everything else will be entirely new, the old building being torn down piecemeal as the new one encroaches upon and overlaps it. The illustrations given in the cuts represent an outline of the ground plan of the new building and some of its more important details. As shown, it consists of a main molding floor, 60×436 ft., served by three 30-ton electric traveling cranes, with two smaller floors parallel to and adjoining it, one on each side, respectively, 30×240 and 30×196 ft., each served by 5-ton cranes, and in addition a series of bays extending at right angles to the main floor and on each side of it, some used for molding floors, others for cupolas, core ovens, core making, etc. Besides this there is a room of trapezoidal shape 190 ft. in length on its longest side for the storage of supplies. The whole area under roof is nearly two acres.

The building is constructed chiefly of iron and glass, as shown in the illustrations. It was designed by Mr. F. Felkel, Civil Engineer and Architect, of Pittsburg, Pa. The framework is unusually massive, the supports being designed for the double purpose of carrying the roof and of resisting the strains caused by the weight and the motions of the traveling cranes, and the roof trusses are built with reference to the possibility of some corrosion caused by the foundry gases as well as for mere strength. Much attention has been paid to the lighting of the foundry. A ridge lantern, 8 ft. high, extends the whole length of the main roof, and there are also roof skylights on each side. Altogether there are 32 skylights varying from 12×16 ft. to 16×16 ft. in size. Smaller skylights are placed in the roofs of the bays. All steel used has an ultimate strength between 65,000 lbs. and 75,000 lbs. per sq. in.



GENERAL PLAN OF FOUNDRY, NILES TOOL WORKS.



ELEVATIONS OF FOUNDRY, NILES TOOL WORKS.

Besides first-class foundry machinery there are eight overhead traveling cranes having capacities of from 5 tons to 30 tons, and a large number of jib cranes. There are four large core ovens 12 ft. wide by 40 ft. long, and four small core ovens with rotary stands for shelf work. The main foundry cranes deliver all castings under the cranes of the machine shop without a second handling. For the drawings and information from which this article has been prepared we are indebted to the Niles Tool Works.

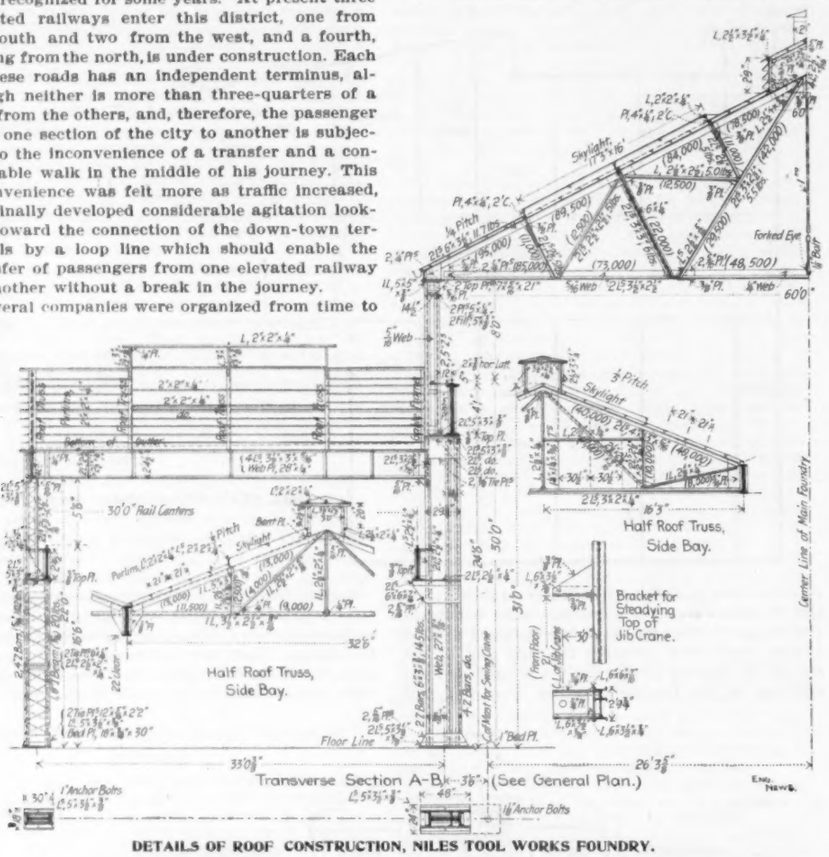
A UNION TERMINAL FOR CHICAGO'S ELEVATED RAILWAYS.

The desirability of a union terminal line to connect the several elevated railway lines terminating in the central business district of Chicago has been recognized for some years. At present three elevated railways enter this district, one from the south and two from the west, and a fourth, coming from the north, is under construction. Each of these roads has an independent terminus, although neither is more than three-quarters of a mile from the others, and, therefore, the passenger from one section of the city to another is subjected to the inconvenience of a transfer and a considerable walk in the middle of his journey. This inconvenience was felt more as traffic increased, and finally developed considerable agitation looking toward the connection of the down-town terminals by a loop line which should enable the transfer of passengers from one elevated railway to another without a break in the journey.

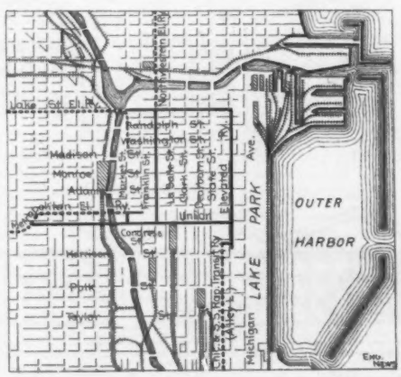
Several companies were organized from time to time in the few years past to build this loop line, but none of them promised much until the Union Elevated R. R. Co. was formed by men interested in the various elevated lines to be served by the loop line. In October, 1895, an ordinance was granted to this company authorizing it to build an elevated railway along Wabash Ave., from Lake St. to Harrison St., and the work of construction was begun early last winter. Turning to the accompanying map it will be seen that this line connected the Lake St. Elevated Ry. at Lake St. with the Chicago & South Side Rapid Transit R. R. (Alley L) at Congress St. As soon as this ordinance had been secured the company began work to secure an ordinance for a second line along Van Buren St., from Wabash Ave. west to near Halstead St., and after considerable trouble with property-owners along the route it was finally obtained, by action of the City Council, on June 30, 1896. These two ordinances provide for the east and south sides of the loop, and efforts, it is expected, will now be made to get power to build a connecting link along Fifth Ave., to form the west side of the loop and complete the connection throughout.

In the accompanying maps the broken lines show the termini and routes of the four elevated railways to be served by the loop, and the solid lines show the route of the loop proper. All the elevated lines have two tracks, and the loop line will have two tracks on Fifth Ave. and Wabash Ave. and along Van Buren St., as far west as Market St. From Market St. west the Van Buren St. line will be single tracked. It should also be noted that a branch from the Van Buren St. line will run north on Market St. one-half block to a connection with the Metropolitan West Side Elevated R. R. This branch will be double tracked as will also undoubtedly be the west side of the loop along Fifth Ave.

According to a reported interview with one of the officials of the loop line, the manner in which the several elevated lines will use the loop is as follows: The Northwestern Elevated R. R. will connect with the loop at Fifth Ave. and Lake St., run east on Lake St., south on Wabash Ave., and north on Fifth Ave. to the starting point, using the outer of the two tracks. The Lake St. Elevated R. R. will use the same route as the Northwestern. The Metropolitan West Side Elevated R. R. comes in on the inner track at Van Buren St. and Fifth Ave., runs east along Van Buren St. and around the loop. The Chicago & South Side Rapid Transit R. R. will use the inner track north on Wabash Ave., and thence around the loop, but just how the connection will be made is not stated.


30'0" Rail Centers
Half Roof Truss, Side Bay.
Bracket for Steadying Top of Jib Crane.
Half Roof Truss, Side Bay.
Floor Line
Center Line of Main Foundry
Transverse Section A-B (See General Plan.)
Eng. News.

DETAILS OF ROOF CONSTRUCTION, NILES TOOL WORKS FOUNDRY.



Map Showing Union Terminal Loop for Chicago's Elevated Rys.

The foregoing gives the general purpose and the method of using the union loop line. The ordinances which empower its construction regulate in a broad way the type of construction and motive power, and specify with some detail the compensation to be paid the city, and the extent to which the company shall maintain city property affected by its structure. Briefly, after the company has deducted $250,000 from its annual gross receipts for fixed charges, it shall pay to the city out of the remainder 5% per annum for the first five years, 10% for the second five years, 15% for the next ten years, 20% for the succeeding 15 years, and 25% for the remainder of the 50 years for which the franchise is granted. It should be noted that as first passed by the City Council, the ordinance provided for no compensation to the city, bribery of the Council being freely charged as being the means to this end. By threat of a veto and an array of the better class of aldermen, however, the Mayor was able to secure the agreement outlined, and on July 6 it was accepted by the Council and the railway company.

The ordinance requires that trains shall be operated by electricity or an equally clean and noiseless power, and it is generally known that electric power will be used. Two of the elevated roads which will use the loop now use electric power, a third is being constructed with this end in view, but the fourth, the Chicago & South Side Rapid Transit R. R. will have to change from steam to electricity. For this change the ordinance allows three years from the date of its passage.

In regard to the style of structure, the ordinance requires that it shall obstruct light and street traffic as little as possible, and to this end lattice girders, open floors and the wide spacing of columns are required. Street crossings are to be spanned by single spans when less than 70 ft. wide. The supporting columns are to be located at least 35 ft. apart longitudinally, and transversely just far enough apart to allow a double track street railway to pass between them. Minor details of construction are also specified, but as they require nothing unusual to ordinary first-class elevated railway construction they need not be mentioned.

The structure is required to be completed and in operation by Jan. 1, 1898, and, as already stated, construction is in progress; the Wabash Ave. line being well on toward completion and the Van Buren St. line just begun. According to the reports of the company's officials, the rapid prosecution of the work to completion depends only upon delays over which they will have no control. A five-cent fare will take the passenger to or from any point on the loop on any one of the lines connecting with it, but will not include transfer from one line to another.

A NEW HOISTING AND CONVEYING APPARATUS.

A new form of hoisting and conveying apparatus, known as the Temperley transporter, invented by Joseph Temperley, of London, England, has come into extensive use abroad, and the American patents on the system have recently been acquired by the Lidgerwood Manufacturing Co., of New York City.

The Temperley transporter employs an I-beam as a trackway, along which the load hoisted is carried by a carriage in either direction to the point desired. The beam is suspended either horizontally or at a moderate incline, and is provided along its bottom flange with a series of stops, at any of which, at the will of the operator, the carriage may be arrested and the load raised or lowered. These stops may be set as near one another as desired; 5 ft. is the usual standard. The beam or trackway may be of any desired length, and arranged, together with its support, in a variety of ways to suit the exigencies of the case.

A special feature of the Temperley transporter is the novel form of traveling carriage employed, the operation and mechanism of which will be readily understood from the accompanying cuts. It consists of two side frames, bolted together, with four wheels for traveling along the lower flange of the I-beam, a large sheave for the lifting rope mounted on the same pin as the suspender, a suspender for holding up the load when the traveler is moving, a pawl to prevent the suspender being lifted prematurely, a guard to keep the ball on the suspender hook when the traveler is moving, a double cam for locking the traveler to the beam when the load is being lifted or lowered, a single cam for locking the double cam, or

securing the suspender when carrying the load, a sliding bolt passing through slots in the cams and frames for alternately locking the cams, a toggle to cant the tooth of the double cam into stops on the beam, and, finally, a check plate to prevent movement of the single cam when lifting or lowering.

Fig. 1 shows the traveler locked to the beam by the double cam, which is in gear with a stop. The double cam is prevented from moving by the sliding bolt, which is hard over to the right and within the straight part of the slot in this cam. The single cam is unlocked and the suspender hanging down and the rope free for lifting and lowering.

Fig. 2 shows the traveler moving down the beam with the load carried by the suspender. The suspender is held up by its bolt being in gear with the gab in the single cam. The single cam is prevented from moving by the sliding bolt, which is hard over to the left and within the straight part of the slot in this cam. The double cam is unlocked, and in such a position that the traveler is free to move up or down the beam. When one cam is locked, the other is always free. The double cam when free is actuated by contact with stops on the beam, the single cam is actuated by the movement of the suspender. The slots in the cam are so designed that the movement of the free cam causes the release of the locked cam, and the release of one effects the locking of the other. This reciprocal action of the cams automatically and simultaneously arrests the traveler and releases the load, or releases the carriage and secures the load. Figs. 3, 4 and 5 illustrate the most novel features of the carriage and explain the action of the double cam, whereby the carriage may be arrested by any stop along the beam. As will be seen the toggle in Fig. 3 is pointing upwards, but in passing the stop is turned to face down, and is cocked in that position, as illustrated in Fig. 4. Fig. 5 shows the cam in position for the carriage being lowered to a stop that it has passed. The toggle comes in contact with a notch of its own, which rocks the cam so that the tooth is projected up into the notch. This resists the further motion of the carriage, releases the load, and the carriage is locked. The beam is usually set at an angle so that the carriage travels in one direction by gravity. If, however, circumstances do not admit of the incline beam, then a counterweight rope is attached to the rear of the carriage and the carriage is pulled back by the falling counterweight.

The great outreach of the transporter makes it particularly well suited for work along rivers where wharves are not provided. It has been put to a number of uses in England, notably for handling coal, both on wharves and vessels, also for stacking timber, discharging cargo, handling ore, coke, baled hay and cotton, and many other kinds of material which are conveniently handled in packages. It has also been used for coaling war ships at sea with great success, many transporters having been supplied to the British Admiralty, and also to the German, French, Austrian, Italian and Russian governments for that purpose. The illustration in Fig. 6 shows an installation recently completed for the carrying out of some public works at Clichy, on the river Seine, near Paris. A temporary wooden jetty has been constructed over the roadway and a timber structure put up to support the beam of the transporter. This beam is 53 ft. long.

The transporter is worked by an electric winch placed under a wooden shelter at the outer end of the jetty. A line of rails connects the jetty with the works, and the method of working is as follows: A set of six Decauville wagons are run on to the jetty under the transporter and these wagons are filled consecutively, the stops on the beam being so arranged as to plumb the center of each wagon. The material hoisted and conveyed consists of stone, gravel, cement, etc., and arrives in lighters which are moored immediately below the outer end of the transporter. The material is filled into tubs, which are hauled up by the transporter and dumped into the wagons, or the wagon bodies are removed from their wheels and lowered into the lighters to be filled. As soon as one set of wagons is filled, it is removed and another set shunted on to the jetty. This transporter has a lifting capacity of 3,000 lbs., and can discharge 50 tons per hour. The electric winch is operated by current from the generating plant at the works some distance away. The electrical energy required by the transporter when at full work is about 60 amperes at 200 volts. The installation at this place has proved very successful.

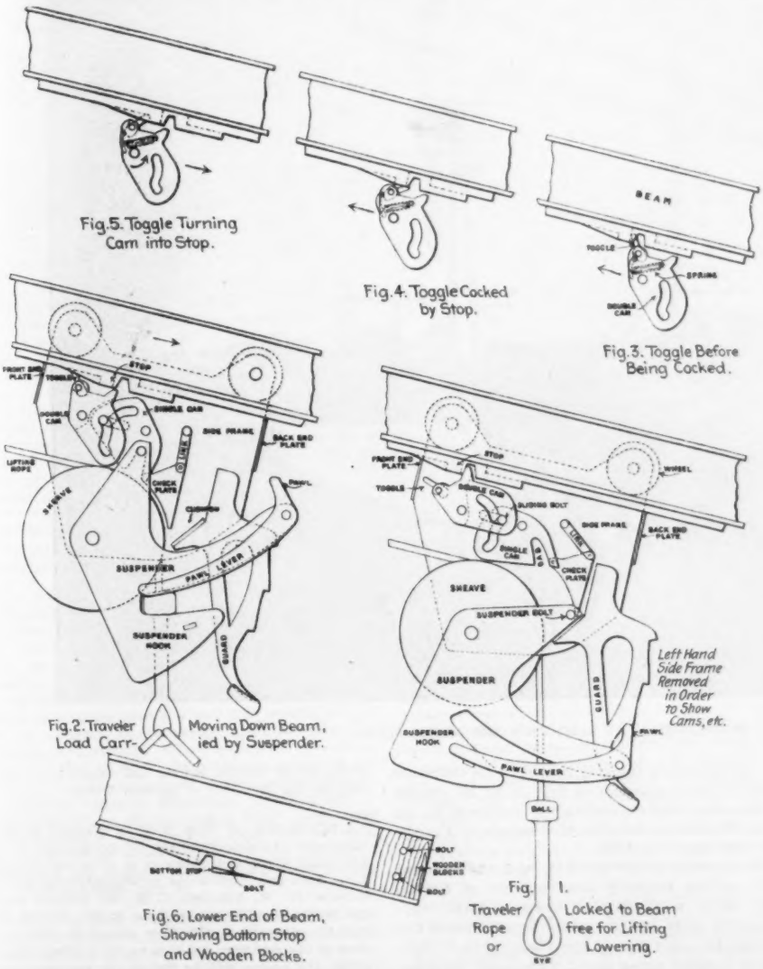


Fig. 5. Toggle Turning Cam into Stop.
Fig. 4. Toggle Cocked by Stop.
Fig. 3. Toggle Before Being Cocked.
Fig. 2. Traveler Moving Down Beam, Load Carried by Suspender.
Left Hand Side Frame Removed in Order to Show Cams, etc.
Fig. 6. Lower End of Beam, Showing Bottom Stop and Wooden Blocks.
Fig. 1. Traveler Rope or Locked to Beam free for Lifting Lowering.

FIGS. 1 TO 6.—DETAILS OF CARRIAGE OF THE TEMPERLEY TRANSPORTER.

THE EARLY HISTORY OF STREET PAVING AND STREET CLEANING.

In his "History of Inventions and Discoveries," John Beckmann, Professor in the University of Gottingen, devotes a chapter to the paving of streets, and from this historical sketch the following more interesting points are taken:

While Roman writers of early date often refer to paved highways and especially describe the famous Appian Way, of 565 B. C., there is comparatively little reference to the paving of streets in cities. The streets of Thebes were regularly cleaned under the inspection of the telsarchs, and it is to be assumed that they were paved; and the Talmud says that the streets of Jerusalem were swept every day, which undoubtedly implies a hard and solid pavement. There is no record of the first street pavement in Rome; but Livy mentions that certain streets were ordered to be paved in 169 B. C., and as early as 530 B. C. the Emperor Heliogabalus paved the streets around his palace with foreign marble. The streets of Pompeii and Herculaneum still show their paving blocks of lava, cut into deep ruts by the wheels of passing chariots.

Passing to later times, we find the streets of Cordova, in Spain, paved as early as A. D. 850, by order of the Caliph, Abdorrahman II. The first record of any street paving in Paris is dated in the year 1184, when the name of the city was changed from Lutetia, the dirty, to Paris. This innovation is said to have arisen from the fact that the King, Philip II., was annoyed by the offensive odors produced by the agitation of the mud in front of his palace by passing vehicles. He resolved to remedy the intolerable nuisance by ordering the streets paved, and succeeded in having this done, in part, at least, notwithstanding the heavy cost, which had deterred his predecessors.

In 1090 the streets of London were soft earth only; but when the first pavement was introduced is not known. Holborn was paved for the first time, by royal command, in 1417; Henry VIII. ordered other streets paved, and the great market square of Smithfield was first paved in 1614. Augsburg, in Germany, seems to have been the first city in that country to introduce footways and street pavement, in 1415, but the extension of the improvement to other towns was slow, and the streets of Berlin were not all paved even in 1679.

Street cleaning was only rendered possible by first providing some manner of hard surface to work upon. Rome had its "tribuni verum intentium" at an early date, officials who were charged with the care and cleaning of the streets, markets, temples, baths and other public places. Ordinances were framed, and more or less severely enforced, forbidding the throwing of any manner of filth into the river or into the streets of Rome. For some centuries after Paris was paved every citizen was compelled to repair the street before his house and to clean it at his own expense, in accordance with an edict of Philip the Bold, issued in 1285. This law was practically unobserved, however, and in the 14th century the streets of Paris are described as in a horrible condition. Later laws made street cleaning com-

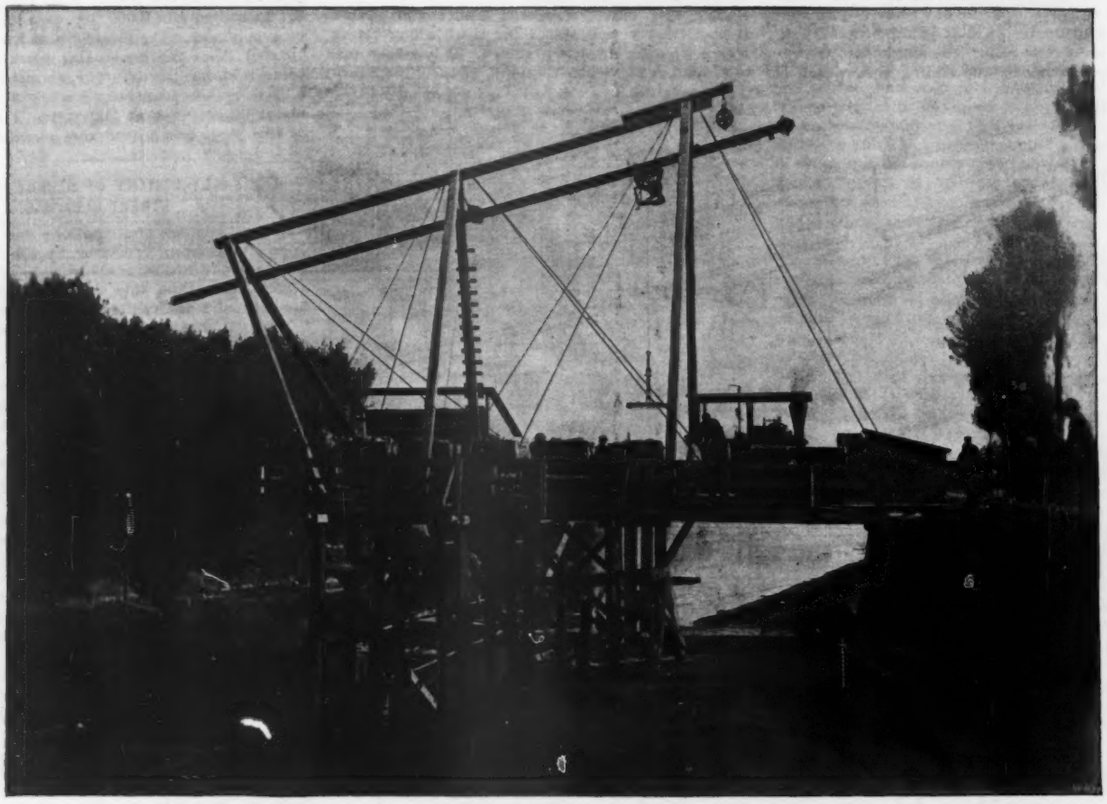
pulsory, for nobles as well as for the common citizen, and in 1501 a company was formed for cleaning streets by contract with individuals. Street cleaning at public expense, in Paris, was inaugurated in 1609, and the sum of 70,000 livres was appropriated for this purpose from the public fund. In 1704 the city collected 300,000 livres for cleaning streets and maintaining lamps.

A pig figures prominently in the first Parisian ordinances forbidding the deliberate dirtying of the streets. The young King Philip, son of Louis the Fat, was killed, in 1131, as the result of a fall from his horse brought about by a pig in the streets. As a consequence of this accident an order was issued forbidding swine running loose on the streets of the city; but this order was bitterly opposed by the monks of the Abbey of St. Anthony, who resented this affront to the charges of their patron saint, and demanded liberty for the swine to go where they pleased. After some time spent in controversy, the pigs belonging to this abbey were granted a special dispensation and permitted to wallow at will, provided that they had bells attached to their necks.

Up to the 14th century, in Paris, and as late as 1750 in Edinburgh, citizens were permitted to throw from their windows any manner of slops into the streets before the house, provided that they called out three times before doing so. This privilege, so inconvenient to the passer-by, was strictly forbidden in Paris in 1395, and from this time may be dated the first introduction into that city of sanitary conveniences. It is interesting to note that when Columbus sailed for the Indies, the palace of King Ferdinand of Spain was destitute of any conveniences of this nature. The Parisian Code of Laws of 1513 expressly orders that every house should have a privy, and severe penalties were imposed for non-compliance with this order; but even as late as 1700 the police were compelled to use the utmost vigilance to prevent infraction of the law and to keep those in use in a fairly sanitary condition.

In Germany the cleaning of streets was at first considered as a most dishonorable employment, which in some places was assigned to the Jews and to the servants of the public executioner. Up to the beginning of the 17th century the streets of Berlin were never swept, and pigs ran at large throughout the city. In 1624 the Elector desired the Council to have the streets cleaned; but the Council replied that it was impossible, as the citizens were busy on their farms. The dirt in the public market place accumulated to such an extent that in 1671 a law was passed compelling every countryman to take out of the city one load of dirt every time he came to market. Pig-sties in the streets were common until 1681, when an order was issued forbidding the feeding of swine within the city limits. The Germans are said to have introduced privies at an earlier date than the French ordinances referred to, as mention of them is made in the annals of Frankfort-on-the-Maine in 1477.

Mr. Beckmann wrote in 1846, and the account he gave of the sanitary conveniences of Berlin, at that date, will surprise some readers. He says that in most of the houses small closets are located on the landings of the stairs, which must be emptied every other night with most unpleasant consequences. In the streets, large puddles of filth were allowed to collect even before the doors of the best houses, and in the summer these puddles emitted "a horrible stench." While the streets were spacious and straight and fairly well paved with flagstone, the footways were divided from the carriage drive by open kennels, "telling the nose unutterable things." Our author closes by remarking of this city that, "If bronze and marble could smell, Blucher and Bulow, Schwerin and Liethen, and duck-winged angels and two-headed eagles unnumerable, would be found on their pedestals, holding their noses instead of grasping their swords."



TEMPERLEY TRANSPORTER AT CLICHY ON THE RIVER SEINE.

THE SUM OF $100,000 FOR SLUDGE DISPOSAL at Worcester, Mass., was appropriated a few days ago by the city council. Since the sewage precipitation plant was put in operation at Worcester in 1890, the sludge has been spread on beds to dry, or partially dry. Its final disposition has been more or less troublesome from the start. It is now proposed to put in a pressing plant, by means of which a large percentage of the moisture will be removed.

A CHEMICAL LABORATORY FOR THE STREET DEPARTMENT of Brooklyn, N. Y., has recently been established for use in connection with asphalt paving work. It is in charge of Mr. W. Homer Broadhurst, a graduate of the Brooklyn Polytechnic in 1894.

THROUGH TRAINS ACROSS THE BROOKLYN Bridge are again being urged by President Ullman of the Brooklyn elevated railways. At the meeting of the bridge trustees, on July 13, he presented a report by Mr. Geo. B. Cornell, M. Am. Soc. C. E., answering the objections presented by Messrs. Martin and Leverich of the bridge staff to the operation of through trains.

A CRITICISM OF THE DESIGN accepted by the Commissioners of Fairmount Park for the new bridge over the Schuylkill River, and shown on p. 13 of our issue of July 2, has been presented to the commissioners by Mr. Percival Roberts, Jr., M. Am. Soc. C. E. Mr. Roberts urges that the bridge should contain three arches instead of four; that the masonry of the piers should be carried to the level of the roadway, and that as the roadway has a 1.2% grade, the arches will be out of the horizontal and will look badly if constructed according to the accepted design. He also claims that the design is for a lighter structure than that called for by the specifications of the chief engineer.

SHIP BUILDING IN THE UNITED STATES was fairly active during the year ending June 30, 1896, according to statistics just issued by the Bureau of Navigation. There were 709 vessels of 204,000 gross tons built, against 682 vessels of 133,000 tons in the previous year. There were 322 steam vessels built of 135,000 tons, against 283 of 75,700 tons in the preceding year. The tonnage of steel vessels built was 106,900 against 47,700 in the previous year. On the Great Lakes 104 vessels of 92,000 tons were built as compared with 93 vessels of 38,000 tons in the year preceding.

THE BOSTON PNEUMATIC TRANSIT CO. is seeking a charter for a general system of pneumatic delivery pipes in the streets of Boston, and is to have a hearing before the Board of Aldermen July 20. A similar charter was applied for a year ago, and was granted by the Aldermen, but was vetoed by the Mayor.